ELECTRICAL WORLD AND ENGINEER

VOL. XXXV. NEW YORK, SATURDAY, JANUARY 6, 1900. No. 1.

PUBLISHED EVERY SATURDAY BY

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

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NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

The first issue of each month is an export issue, having an extraordinarily large foreign circulation in addition to the regular domestic and foreign circulation of this paper.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico . . . . . per year, $3.00
Foreign Countries within the Postal Union, ... 6.00
Single Copies, ...10

In requesting your address changed give OLD as well as new address.

(Entered as second-class mail matter at the New York Post Office.)

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ELECTRICAL EXPORTS.

In discussing the financial and economic aspects of last year, Secretary Gage, of the United States Treasury, mentioned first of all the fact that the total foreign trade of this country reached $2,000,000,000 and that the exports had exceeded the imports by not less than $450,000,000. The year before, the export excess was about $600,000,000 and might have reached nearly that figure again were it not for the large and growing importations of raw material. Those of us who are interested in foreign trade development—and who is not?—must be gratified at this showing. As Mr. Gage also puts it: "By enterprise and ingenuity, we have found a way into the markets of the world for our manufactures to the extent of $68,000,000 more than they were last year. We have bought in the year, from all our foreign friends, $158,000,000 more of their goods than we bought in 1898. That is not only a sign that we are able to buy, but it is calculated to encourage buying by those from whom we have made larger purchases."

This is well stated, for upon such ideas of reciprocity the most profitable and enduring trade is always based. So far as electrical exports go, the past year was a period of striking growth, but there is no good reason why, in view of the favorable reception accorded American electrical apparatus, steam machinery, and scientific instruments, the quantity and value exported should not be twice as great as it now is. To this end we and our readers may well direct attention, encouraged by such evidences as are given constantly of appreciative customers, located throughout the wide world. The most casual glance at our commercial news will show how universal is the field now opened up for cultivation.

THE INDEPENDENT TELEPHONE MOVEMENT.

With the expiration of Bell's fundamental patents, in 1893 and 1894, the present independent telephone movement had its real beginning. As viewed from the surface the movement was weak, unhealthy, and unlikely to succeed. Aside from the patent situation, the Bell Company has had almost a monoply of the knowledge and experience requisite for the successful manufacture and operation of telephone exchanges, and with its hundreds of exchanges in operation, its systems of interurban lines connecting them, its reputation, its prestige, and its enormous financial resources, it seemed impossible for any widespread opposition to gain a permanent footing.

The extent to which the unexpected has happened is shown in some measure in our elaborate illustrated articles in this issue describing the independent telephone exchange at St. Louis. Such an exchange completely equipped for 8800 lines and embracing the largest switchboard in the world shows to what a degree the confidence of capitalists in the independent field has attained. The fact that this exchange has been installed and is operated without successful interference on the score of patents, would seem to imply that either the pioneer company is not as strongly entrenched through its patents as the public has been inclined to believe, or that the engineers in the independent field by new inventions, new applications of old ideas and the intelligent selection of apparatus and

methods free from infringements have been able to produce competing telephone exchanges complete in every detail.

While the Bell Company and its licensees have many more telephones in operation in the United States than all of the independent companies combined, and are growing very rapidly, it is a somewhat surprising fact that the number of independent exchanges is apparently in excess of the total number of Bell exchanges. Some of these independent exchanges were better out of existence. But in view of the other conditions, it would seem that the principal requirement of the independent companies to place them on a more nearly equal footing with their great rival, is, as we have often pointed out, the development of a system of interurban lines on a par with that now controlled by the American Telephone & Telegraph Company. That is promised some time in the near future.

The Kinloch exchange at St. Louis presents many features of interest, the greatest of which perhaps is that it is the first exchange to employ the divided exchange multiple board. The idea of dividing a multiple switchboard into two, three or four divisions, and providing means whereby a subscriber may register his call in any one of those divisions at will, would but a short time ago have seemed impracticable. Heretofore it has been generally considered visionary or undesirable to build an ordinary switchboard capable of accommodating more than 6000 subscribers, but by a four-division multiple board of the type used at St. Louis, this limit is readily raised to approximately 24,000 and apparently without any excessive complications of parts as compared with the single-division board. One of the results of this new departure may be that in large cities the war between the American Bell Telephone Company and the opposition will be carried out on the issue of single exchanges versus numerous small ones. Each method undoubtedly has its advantages, and with the energies of the two great telephone factions each bent on following out its own particular ideas, the developments in the next few years will be watched with keen interest. That a notable advance in the telephonic art impends, with marked benefit to the public, is obvious, and it is the improvement and perfection of the art that is after all the great and final consideration.

THE FINANCIAL YEAR.

Week by week the course of the financial year in electricity has been recorded in the pages of this journal, with running comment on the situation. When a backward survey is taken of the whole period, it is seen that the activity has been well sustained, but with varying fortunes in the public estimation of the value of the various stocks and bonds. For example, the year's record of sales of Western Union stock is 583,911 shares with a closing price of 85, a net decline of not less than 8¼; while the bonds are sympathetically lower also. General Electric, on the other hand, was dealt in to the tune of 366,958 shares, closing at 123¾, a net gain of 28, while its 5 per cent. debentures are up 5½. Brooklyn Rapid Transit was juggled to and fro to the extent of over fifteen million shares, closing at 72¼, although last April it was up to 137. Another typical traction is New York Metropolitan, of which 1,759,584 shares were dealt in. This reached during the year 269 and closed at 175¾. The mere statement of such figures as the latter shows that if the pendulum swung too far one way it has lately swung too far the other, and a fair inference is that 1900 should see a marked improvement in present values. This would appear not less true of such newcomers as Electric Vehicle, representative of the automobile group. The common stock in this security stood below 20 last January, and advanced to 151, the preferred similarly going from 60 to around 140. At present the highest quotations cut those figures squarely in twain, and yet 1900 is going to be the best automobile year that has ever been known. Thus also has it been in Bell telephone stock which still quoted solely on the Boston market has been up within hailing distance of 400 and has dropped from around 390 to 340. Here again is an electrical industry destined to infinite expansion, with, probably, 1900 as the best year it has seen.

On the whole, those who study, deal in and buy electrical securities have no reason to grumble at the results of 1899 if a long view be taken and if transactions are based on ordinary prudence. In 1900, the opportunities will not be less than they have ever been. Taking the field of electrical illumination and power, for instance, it is safe to say that the regular growth of the central station business in such cities as New York and Chicago calls for the new investment in each of from one to two million dollars every successive year, with an almost absolute assurance of permanent good returns. This is equally true of Boston, Philadelphia and every other city in which a progressive company operates. These systems of a public service character, are among the best presented to the saving, investing public for patronage, and the municipal legislation that protects them can not be too liberal in its treatment of them. Whatever profit they make for their shareholders is reduced to insignificance alongside the benefits they confer on the community.

A PACIFIC CABLE.

A hundred years hence it will perhaps be interesting for somebody to look back and go over the data with which it is sought to show that an American Pacific cable is needed. If cabling is then still depended upon, rather than wireless methods, there will probably be as many cables in the Pacific as there now are across the Atlantic, each one of them earning at least its salt. All those who heard or have read the admirable paper presented by Capt. G. O. Squier, U. S. V., before the American Institute of Electrical Engineers, realize the imminence of the problems connected with laying the first of these cables. The Institute has done a public duty in bringing the matter before its members, many more of whom are likely to become personally interested in the subject than now happens to be the case. No matter what our English friends may do —and it is to be hoped that this great work may be carried on with them in close harmony—the coming magnitude of direct American interests in the Pacific demands that this country shall have a leading voice in the control and management of the new cables. Whether the cables shall be actually owned and operated by the United States Government, as urged with so much force and insistence by Capt. Squier, is a question for Congress to settle. We should prefer to see the cable left in private hands, but we would much rather see the Government put it down than go longer without such an invaluable aid to trade and commerce and the direction of our colonies. Capt. Squier's paper is a most timely contribution to a vital question.

ECONOMY IN ELECTRIC LIGHTING.

In a paper recently read by Lieut. F. W. Willcox before the Franklin Institute, an abstract of which will be found elsewhere in this issue, it is estimated that between 15,000,000 and 20,000,000 incandescent lamps of all kinds are used in this country annually, representing a value of between $3,000,000 and $4,000,000. Nothing could better illustrate the vast growth of the electric lighting industry than these figures. The improvements in the manufacture of incandescent lamps have, too, kept pace with progress in electric lighting, though perhaps the most marked improvements have been made in the past four or five years. At present great initial uniformity of the filament is secured by the squirted process, and the chemical process of exhaustion insures a greater uniformity of vacuum than was commercially possible with the old mercury pumps. The process of hydrocarbon treatment necessary to give the old type of filament

the uniformity which it lacked initially, has been recognized of great value for another property—that of increasing the efficiency of the filament through the greater emissivity from the coating of graphitic carbon deposited from hydrocarbon gases used. It appears quite probable that the limit for the improvement of the carbon filament has been nearly or quite attained, and greater economy in electric lighting as affected by the incandescent lamp, must be looked for in another direction. The next step appears very plainly to lie in the direction of improvement in central station practice with respect to regulation and means for securing lamps of accurate rating.

The cry of central station men has been at times for a higher economy lamp and again for lamps of higher voltage. It has not always been recognized, however, that both of these desiderata are involved in the question of burning lamps at their proper voltage and at this voltage only. This latter is dependent on two factors—close regulation and using lamps corresponding exactly to the voltage under which they will be burned. Taking up this latter requirement, it will be seen to be subject to two conditions, one having reference to the manufacturer and the other to the user. As there is a drop in distributing circuits, a lamp installed near the station will not be subjected to the same voltage as one installed at a distant point, which indicates the desirability of using two or more voltages on a central station distributing system. On the other hand, as pointed out by Lieut. Willcox, a very considerable proportion of lamps do not test in the factory to the voltage aimed at, some going above and some below. Consequently, the incandescent lamp user cannot always depend upon being supplied with lamps correctly rated. For the protection of the user, therefore, the necessity of carefully testing lamps purchased is obvious, and on the part of the manufacturer, the desirability of having a sale for product not of a standard voltage is also obvious. Lieut. Willcox suggests that a number of central stations shall agree to run at different voltages in order that lamps of odd voltages shall find a market. This would undoubtedly greatly relieve the lamp manufacturer, and should result in decreasing the selling price of lamps, while not placing any hardship on the buyer or user.

PHASE CONVERTERS.

Prof. Quick's interesting article appearing this week is a valuable contribution to the subject of converters. These machines have had their joulean losses analyzed for conversion from direct currents to alternating current of any reasonable number of phases, or reciprocally; but the corresponding analysis for m-to-n-phase conversion does not appear to have been published.

The salient generalization reached by the analysis is that in all cases of m-to-n-phase transformation, a tapping point on one side of the armature for m-phases should coincide with a tapping point on the opposite side of the armature, for n-phases. As an example, it would appear that the joulean waste in armature conductors is best in single-to-three-phase transformation, when the armature being tapped at a diameter on one side for single-phase, and at two mutually perpendicular diameters on the other side, for two-phases, the single-phase tap diameter coincides with one of the two two-phase diameters.

We regret that owing to Prof. Quick's untimely death, the appearance of his paper in print should have been denied to him by the conqueror of all.

DIFFERENCE OF PHASE.

Mr. Alexander Russell's communication, appearing in our correspondence columns, calls attention to the want of precision which often accompanies the use of such terms as "phase-difference" and "power-factor." In dealing with simple alternating-current circuit containing sinusoidal electromtoive forces as well as uniform resistance and reactance, the phase difference between the current and the impressed e. m. f. at any part of the circuit is a perfectly definite quantity, being the ratio of the time interval between the moment at which the e. m. f. is zero and the nearest moment at which the current is zero—to the periodic time of either. This ratio is ordinarily multiplied by 360 and expressed, as an angle, in degrees. The cosine of this angle is the power factor.

The above conditions represent idealites as distinguished from working realities. In practice, the electromotive forces are complex harmonics, as also the currents. If, however, the resistances and reactances are uniform, a slight extension of definition will cover the new case. The electromotive force and current, being no longer sinusoids, are measured by their effective values, or square roots of mean squares, and their real power is assumed to be measured by a wattmeter. The ratio of the watts to the volt-amperes is now the power-factor, and the phase difference is the angle whose cosine is equal to the power-factor. This angle no longer corresponds precisely to the interval between the successive zero-passages of the pressure and current waves. It is a fictitious phase-angle. For the same reason, the pressure and current may be "in step," i. e., the zero-passages of the pressure and current may be coincident, and yet their power-factor may not be unity, and, consequently, their theoretical phase difference will not be zero. In such cases, however, we virtually assume that the currents and pressures are simple sinusoids having the same effective values as the actual complex pressures and currents respectively. The phase difference according to our definition is then that corresponding to the interval between the successive zero-passages of the hypothetical equivalent sinusoids. This is entirely satisfactory in the great majority of complex alternating current circuits, and is the method ordinarily adopted.

Although, as above stated, the phase difference in a practical alternating-current circuit is a fictitious quantity, generally differing from that which would correspond to the interval between adjacent zero-passages of pressure and current waves; yet the difference is ordinarily small. If the power-factor of a certain part of the circuit, by wattmeter measurement, is, say, 0.5, with inductive reactance, the phase-difference is by definition —60°; and if the periodic time is, say 0.04 second, corresponding to a frequency of 25 periods, we should expect the current to pass through zero nearly 0.006667 second, or one-sixth of a period, behind a zero passage of the pressure, and actual measurement would in all probability show a lag between zero-passages of roughly this amount.

One marked exception occurs, however, in practice, when, as in alternating-current arc lamps, the resistance varies periodically during the cycle. Under this condition, the current wave may be so distorted, and differ so markedly from the pressure wave, that although the two are always "in step," or have coincident zero passages, the power factor may be as low as 0.6, and the phase-difference by definition 53° approximately. Consequently, we may safely assume that under ordinary practical conditions, when the power factor of a circuit, or branch, is approximately unity, and the theoretical phase-difference therefore approximately nil, that the pressure and current will be nearly in step, and that the out-of-stepness will increase as the apparent phase-angle increases. But when the resistance of the circuit fluctuates periodically as in arc lamps, we may expect the apparent phase difference to be quite other than the out-of-stepness; and as a fact in arc lamps the apparent phase-difference may be large, although pressure and current are in step.

Convention of the Missouri Independent Telephone Association.

The second annual convention of the Missouri Independent Telephone Association was held December 28 and 29 at the Lindell Hotel, St. Louis, Mo. Thirty members were in attendance, representing about fifty exchanges. Among those present were: W. N. Wicks, of Glasgow; C. E. Betts, Fayette; John M. McCulley, Shelbina; George R. Armstrong, Pierce City; A. R. Ponder, Cape Girardeau; John Enoch, St. Charles; John E. Brooks, Cape Girardeau; A. A. Tibbe, Washington; John W. Lane, Carthage. M. A. King, St. Louis, and John W. Lane, president of the Carthage Electric and Telephone Company, were elected to membership. J. A. Hudson, of Macon, presided, and Theodore Gary, of Macon, acted as secretary.

The object of the meeting was to secure better connections throughout the State; improve the lines in the State, also the exchanges, and to make arrangements for connecting with the large cities throughout Missouri. The principal subjects discussed at the first day's session were "The Dollar Telephone;" the necessity for a standard of construction material and the advisability of incorporating so as to make it more beneficial to members.

The second day's meeting was devoted to the election of officers, which resulted as follows: President, John Enoch, St. Charles; Vice-President, Geo. R. Armstrong, Pierce City; Secretary, Theodore Gary, Macon. Executive Committee: John Enoch, Geo. R Armstrong, M. A. King, J. A. Hudson and John F. Brooks.

A special meeting will probably be called in the spring to consider questions affecting the association's interests. In view of this meeting a resolution was passed that the gathering be held in Joplin. Kansas City was objected to on the ground that inde pendent telephone lines were opposed by officials of the city. St Louis was considered more friendly to independent lines than Kansas City, but the assurance of President Bassom, of the Joplin Telephone Company, that those who may attend that special meeting would be entertained in that city without cost, saved the day for Joplin. Nothing more definite was done in the movement to connect all the small exchanges throughout the State, than to appoint a committee to select a standard specification. It will take about three months time. It is said that the independent companies hope to secure a long distance service for their subscribers during the year.

A resolution offered to the effect that in long distance service lay the strongest point of the independent companies and was necessary to their existence, passed unanimously.

The meeting adjourned subject to the call of the president.

Exhibits were made by the American Electric Telephone Company, Chicago, in charge of the president of the company, P. C. Burns, and S. J. Bear; the Central Telephone Electric Company, St. Louis, and the Western Electrical Supply Company, St. Louis. All kinds of switchboards, telephones and general supplies were exhibited.

Combination of Telephone Interests.

A Cleveland despatch dated Dec. 30 states that a committee representing the independent telephone interests of Indiana, Ohio, Michigan and Pennsylvania has been at work in that city for a few days perfecting plans for a long-distance service and a working combination between the independent companies of those states. The plans were completed and the committee adjourned. Each company will maintain its individuality. A clearing house will be established, similar to that of the banks, through which the various companies will do their business and balancing of accounts with one another.

After the committee adjourned it issued a statement, the burden of which follows:

"Up to the present the independent telephone companies have been interchanging business within their respective states under such arrangements as seemed to meet the requirements of local business, but the volume of business has grown to such proportions, and the interchange of service between the various states has become so great that it is deemed necessary that there be a consolidation for the purposes of interchange of business between the various states interested under some general rules and regulations relative to rates and methods of handling the business as well as the construction and equipment of lines.

"Through the work of this committee the independent telephone companies of these states have effected such a combination for working purposes and interchange of business as will insure to the public every facility and as good service for local and long-distance purposes as is possible to be rendered by any company or combination of interests. This committee will fix a basis for rates that will be uniform throughout the territory governed by the combination."

Meeting of the American Institute of Electrical Engineers.

The one hundred and thirty-eighth meeting of the Institute was held at 12 West Thirty-first street, on Dec. 27, President Kennelly in the chair, about sixty members and guests being present. A communication by H. H. Wait, of Chicago, was read by Mr. Albright, on "The Cost of Arc Lighting," being in discussion of Prof. Robb's paper presented Sept. 27.

A paper was also read by Capt. George O. Squier, United States signal service, on "An American Pacific Cable," which was illustrated by lantern slides. The discussion was opened by Mr. Herbert Laws Webb and participated in by Messrs. Hallberg, Hughes, Kennelly and Pupin.

At the meeting of the executive committee in the afternoon the following associate members were elected: Carl Ernst Hardy, student, Cornell University, residence 306 Heustis street, Ithaca, N. Y.; Homer M. Jaquays, lecturer in mechanical engineering, McGill University, residence 862 Sherbrooke street, Montreal, Quebec; Seizo Misaki, chief engineer and superintendent Hanshin Electric Railroad Company, Front Sannomiyo Station, Kobe, Japan; Virginius Daniel Moody, senior student, Cornell University, residence 215 Dryden road, Ithaca, N. Y.: Jeremy F. Taylor, electrician, Detroit Copper Company, Morenci, Ariz.: Frank A. Wolff, Jr., professor of physics and electrical engineering, Corcorcan Scientific School, Columbian University, and in office U. S. Standard Weights and Measures, Washington, D. C.

The following associate members were transferred to membership: Ernest Holcombe Hewlett, electrical engineer in chief control, Rockhampton Gas & Coke Company, Ltd., residence, Estoril, Rockhampton, Queensland, Australia; Charles Edwin Knox, with C. O. Mailloux, consulting electrical engineer, 150 Nassau street, New York; Wm. Corwin Burton, with J. G. White & Co., 29 Broadway, New York city.

The Institute has been taking steps to hold a meeting in Paris jointly with the English Institution of Electrical Engineers, about the time of the Electrical Congress in August. Nearly 50 American members have already signified their expectation to attend.

The Recent Great Fire in Philadelphia.

Philadelphia underwriters have made a careful investigation of the recent department store loss in that city, by which the insurance companies will lose $1,000,000 or more. Although the fire was, as usual, called an "electrical loss," due to defective equipment or imperfect insulation, the facts do not point that way at all. Two unknown men were seen struggling mysteriously out of the coalhole just as the patrol service arrived. Whether they had legitimate business about the building is not known, but the circumstance is regarded with suspicion and may lead to arrests. The report says in part: "Attention is also called to the fact that several of the watchmen testified that the electric lights were burning at the time the alarm of fire was given, and were not extinguished until some minutes later. This would tend to show that the lighting circuit was in good order until after the fire had started, and could therefore have had nothing to do with the cause of the fire. On the other hand, the following points brought out in the testimony should be borne in mind, viz., the escape of unknown parties through a coal hole, their presence in the building being unaccounted for by the watchmen; the habit of the watchmen of carrying matches to ignite tapers, and the fact that the last station in the basement visited by the last watchman was the one near the spot where the fire was said to have started, and that his next station was upstairs, where it was necessary that the taper should be burning in order to light the gas."

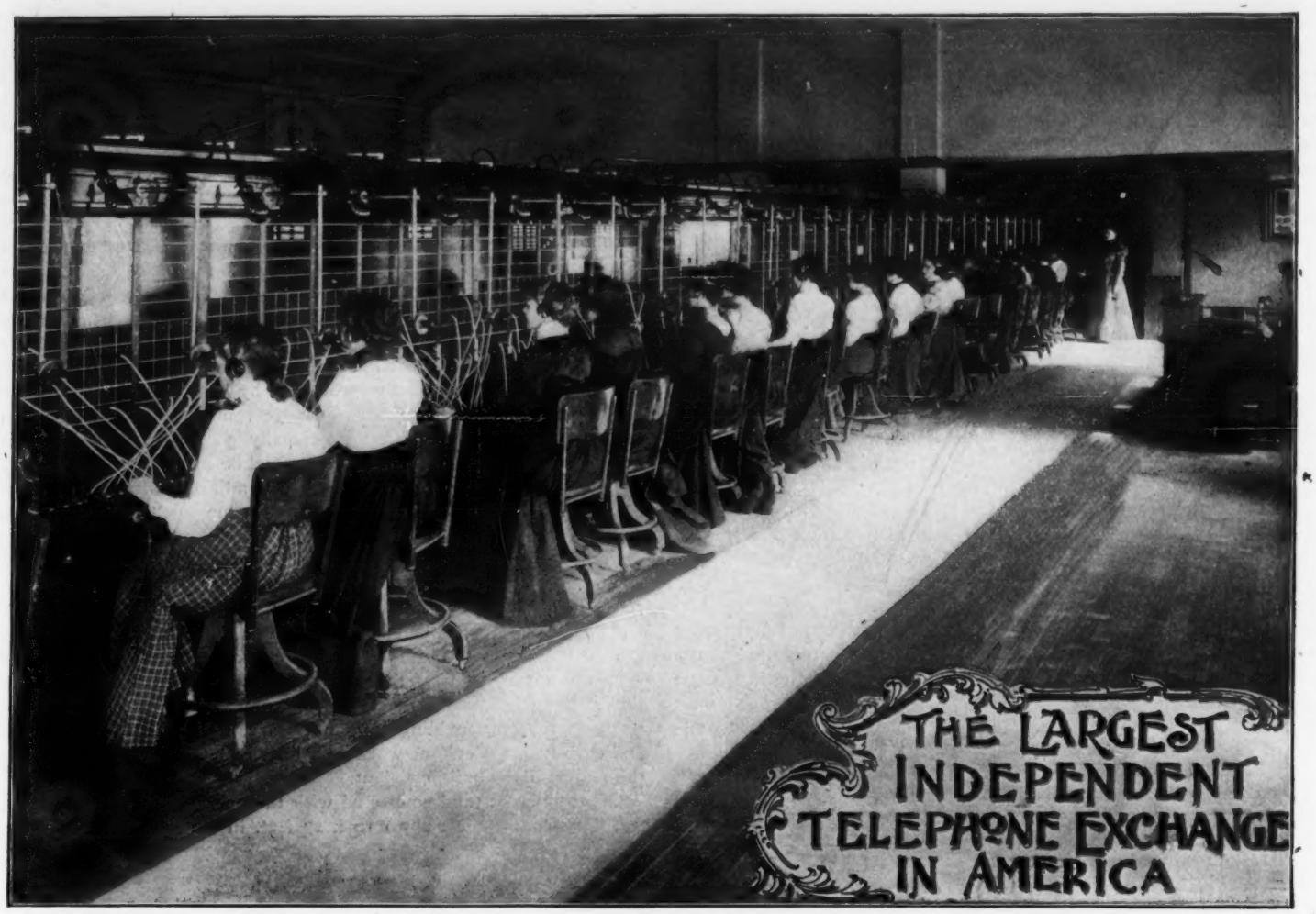


FIG. 1.—ONE SIDE OF THE LARGE SWITCHBOARD, KINLOCH TELEPHONE EXCHANGE, ST. LOUIS, MO.

The Kinloch Telephone Exchange, of St. Louis, Mo.

BY FREDERICK E. BAUSCH.

THE advent of an instrument by which speech is transmitted with a velocity of light, and all inflections of the human voice preserved, bears a significance to the material business and social prosperity of the people which stands unprecedented in the annals of human inventions. A means of communication destined to revolutionize business methods, bringing us face to face, though separated thousand of miles, is that delicate piece of mechanism first presented to the public a little over two decades ago, the "telephone."

In recent years, of all enterprises associated with electrical science, none has been marked by more activity and pursued with more keen interest by inventors, experts and the public alike, than the telephone business. Its remarkable growth and development has been hastened by the ever increasing public demands. Efficient operation and prompt service are inherent requisites of a telephone system, but the public further demands the telephone's universal extension by a reduction in the subscriber's rate, resulting in a maximum working number of subscribers connected to the system and a proportionate enlargement of the telephone's usefulness. A telephone company organized on a broad basis to meet these necessary conditions and one which has proved itself pre-eminently successful in the unusual increase of its patronage since its organization is the Kinloch Telephone Company, of St. Louis. At present it ranks foremost in point of size and importance among the "Independent Telephone Companies," so termed, because of their entire independence of organization and operation from the Bell Telephone system, as controlled by the American Bell Telephone Company.

On Dec. 5, 1896, precisely three months after the city ordinance was adopted, regulating the construction and operation of underground conduits in St. Louis, the Kinloch Telephone Company was organized by Mr. Hopkins J. Hanford, who has been prominent in the organization of other independent telephone companies, notably the one in Detroit, with a patronage of 5000 subscribers. The Kinloch Telephone Company, as at present incorporated, has a full paid capital stock of $2,000,000 with an authorized bond issue of a like amount, and its directorship is composed of the most prominent and influential business men of St. Louis. The policy adopted by the company in its terms to subscribers was very liberal, offering in its contract service without charge until 4000 subscribers were in actual working operation. The rates, per annum, for telephone service were fixed at $60 for business firms, $50 for physicians and $36 for residences.

Fortunately for the company there were no old poles or wires to be removed from the underground district, as was the case with all other wire-using companies. This district comprises an area in the heart of the business territory extending one and a half miles east and west by about three-quarters of a mile north and south. The ordinance regulating the underground work, in brief, provides that no wires, tubes or cables, conducting or transmitting electricity, shall be placed above the surface of the street, alley or public place in the district bounded on the east by the Mississippi River, on the west by the west line of Twenty-second Street, on the north by the north line of Wash Street, and on the south by the south line of Spruce Street and its prolongation to the west line of Twenty-second Street, after Dec. 31, 1898, except those necessary for local distribution.

In the underground district the three principal lines of conduit of the Kinloch Telephone Company running north and south are on Seventh, Ninth and Eleventh Streets. West of Eleventh Street the alleys take the runs east and west. East of Seventh street, in the business district, the conduits are on alternate streets running east and west, distributing from cable heads on poles in the alleys or from terminal heads located in the basement of office buildings.

The company used a multiple duct vitrified clay conduit manufactured by John T. McRoy, of Chicago. This tile was laid in two, three, four and six-duct sections, the latter two sizes being principally installed. It is made in 6-foot lengths and is of hard burned shale with an exterior and an interior salt glazing. The openings in the conduit are about 3 inches in diameter. The external appearance of one of the conduit sections is rectilinear with corners curved.

See supplement for further illustrations.

This type of conduit combines a number of commendable characterisitics. The vitrified clay with glazed surface offers a material unharmed by any corrosive action of the soil and is impervious to moisture. The inner glazed surface is well adapted for readily drawing in cable. The multiple duct feature and the 6-foot lengths proved of exceptional advantage, as it materially aided in constructing the conduit.

Where joints were made, steel dowel pins one-half inch in diam-

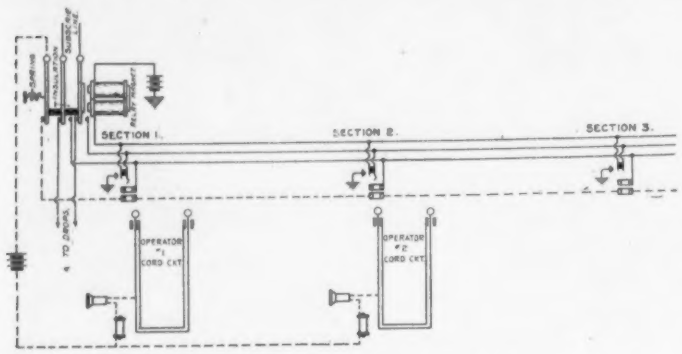


FIG. 2.—OPERATOR'S TEST CIRCUIT CONNECTIONS.

eter and 6 inches long were used to connect adjacent sections. The dowel hole runs through the entire length of the tile, thus permitting smaller lengths cut from the full size to be joined together in the regular manner. This device aided alignment and strengthened the joints. After the pin was inserted the joints were wrapped with wet burlap to insure the proper adhesion and plastered with a coating of cement mortar.

The manholes were built in the following sizes—3½ x 3½ feet, 4 x 4 feet and 5 x 5 feet, with 6 feet head room and 12-inch concrete floors. The smaller size has a corbeling top, on which is supported a cast-iron frame, and circular cover, 36 inches in diameter. The larger manholes have 18-inch walls about half-way and 13 inches the rest of the way. The roof is formed of concrete and 6 x 2 inch "I" beams. On this the iron frame and cover are supported. The telephone company has installed about 600,000 duct feet of this tile.

The Kinloch Company set the pace for the other wire-using companies which were required to go underground. They were the first on the ditch, for on the 7th of March, 1897, the trench was begun, and four months later, by July 7, the conduit was finished. In September the first cable was drawn through the ducts, and by April, the following year, the underground work was complete. Simultaneously about 12,000 poles were set in the outlying district and cables and wires strung for the overhead lines. In this construction the exceptionally straight poles and faultless alignment have given rise to frequent comment.

The Kinloch Telephone Company occupies the tenth floor of the Century Building, a fireproof structure, substantially built of iron and stone, and most modern in construction throughout. The location is in the centre of the business district, at the northwest corner of Ninth and Olive Streets, directly opposite the Post Office. The executive and engineering offices are conveniently located on the east side of the building, while accommodations for light and space in all the various offices are unexcelled. On entering the "telephone exchange" one is impressed with its spacious dimensions and the good ventilation, artificially produced by two large fans, motor driven, located in the entrance to large funnel-shaped openings on the west wall. This is an exceptionally good feature of the exchange, as all impure air is exhausted while pure air is continually supplied, offering the most favorable conditions for the requisite activity of the operators, and insuring prompt service at all times. The floor dimensions of the operating room are 50 x 85 feet.

In the northeast corner of the basement all underground cables enter the building through a vault and terminate in cable heads in a room 45 feet 4 inches x 14 feet 8 inches, called the "terminal room." On their course from the terminal room to the distributing board on the tenth floor, the cables pass through a shaft 8 x 10 x 120 feet deep.

In the power room of the basement, where the electrical plant of the building is located, the telephone company has installed a local plant as reserve, enabling it, if necessary, to furnish its own light and current for telephone work. Ordinarily, current is supplied from the mains of the building plant.

Off to one side and connected with the operating room is the distributing room (see Supp.) 16 x 27 feet, in which are located two large distributing frame racks each 26 feet x 5 feet, from which the lines pass to the switchboard, where they appear in a manner to be described later.

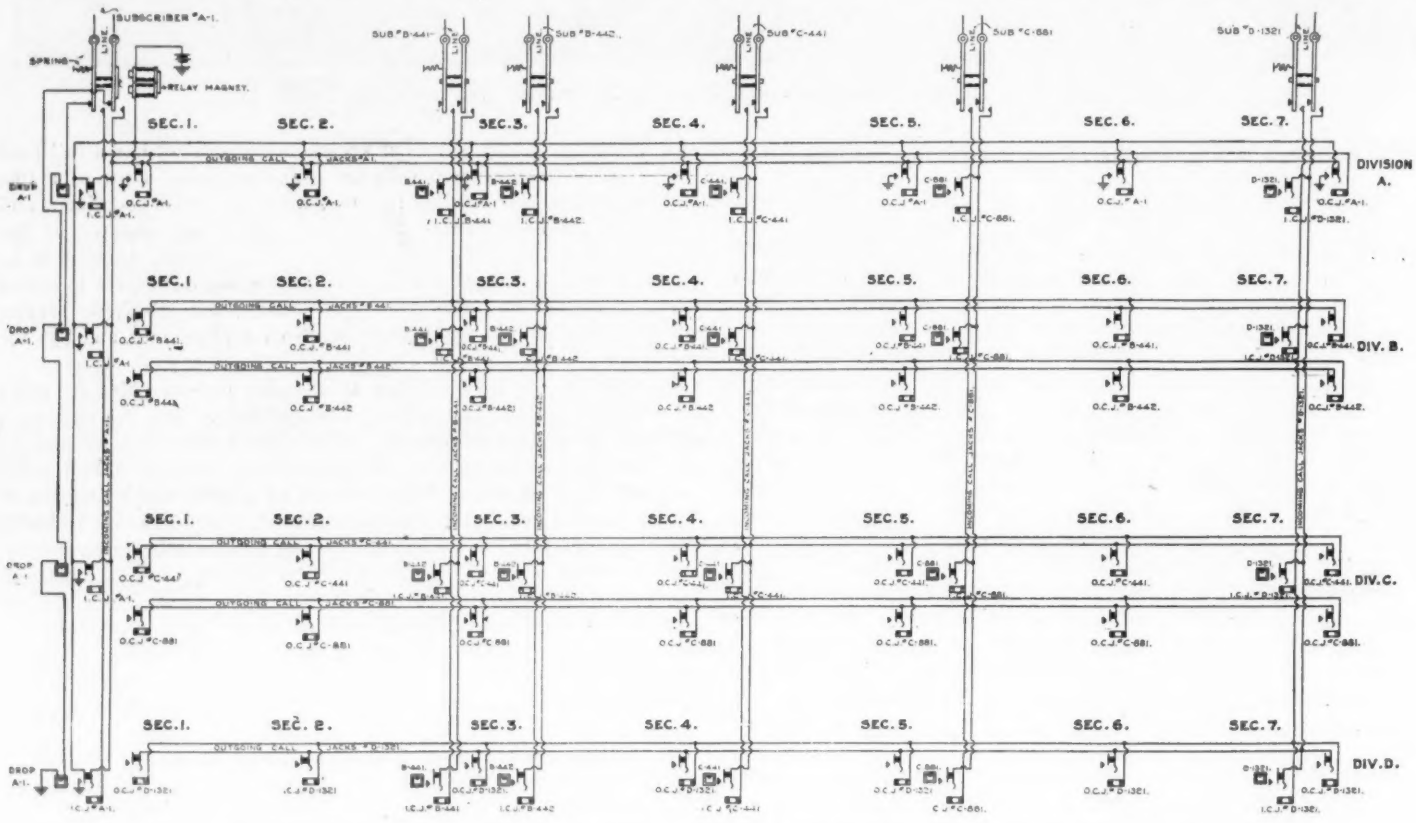


FIG. 3.—SUBSCRIBERS' CIRCUIT CONNECTIONS, KINLOCH TELEPHONE EXCHANGE, ST. LOUIS, MO.

In cases above the distributing frames are the line relays, connected in circuit with each line. From the distributing frames the lines pass to the rear of the switchboard (Fig. 5), where they terminate in the respective "incoming and multiple jacks." From here they are multiplied or duplicated through the various sections and divisions of the switchboard. The distributing frame permits of

such changes as become necessary from time to time, and offers facilities for rearranging lines to equalize the work shared per operator.

On a table in the distributing room are two motor-generators, transforming current from 110 volts to 10 volts, for the two sets of 4-volt storage batteries, which supply the current for the operators' transmitters. In addition to these, two one-third horse-power alternating-current motors supply the ringing current for signaling a subscriber from the switchboard. A marble power switchboard in the same room controls the motor circuits. (See Supp.)

The plan of operation of the Kinloch telephone system is a radical departure from that adopted by the Bell telephone system throughout the country and exemplified by the Bell Telephone Company of Missouri, operating in St. Louis. In a large city the Bell Company begins by establishing a main exchange, located centrally with reference to the immediate and anticipated future needs of a good telephone district. As the subscribers increase beyond a definite number, limited by certain features of the multiple switchboard system, branch exchanges are established in the various outlying telephonic centres. These are tied together and to the main exchange by means of a system of trunking. This arrangement permits of certain advantages which, however, are outweighed by numerous disadvantages.

On the other hand, the Kinloch Telephone Company has but one exchange and one switchboard, on which all subscribers' lines terminate. Here a subscriber on calling up is immediately and positively connected to the desired subscriber by the same operator, who receives and completes the call. It is needless to say that the trunking system means increased opportunity for delay and error, which is almost wholly eliminated by having but one switchboard, on which all operations are performed and over which immediate supervision can be exercised by one set of individuals.

Indeed, a striking illustration of the advantages to be derived from such concentration is apparent in the parallel case of an electric light and power company possessing a number of smaller stations equipped with smaller units of machinery, and interconnected by means of switchboards of varying capacity, as compared with a large central station where one switchboard operates and controls the entire plant. Thus with one plant the personnel required for management and operation, expenses of rental, fuel and light, are reduced to a minimum. Changes and additions of subscribers' lines can be rapidly made, trouble quickly detected and uniformity of service established in a most effectual manner. It will also be shown that with the regular multiple switchboard type, characteristic of the Bell system, the larger the exchange becomes the greater is the cost per subscriber's line equipment at the switchboard, so that, from the very nature of its construction, it becomes imperative to limit the size of any one exchange office to from 5000 to 6000 lines. Hence the necessity of branch offices.

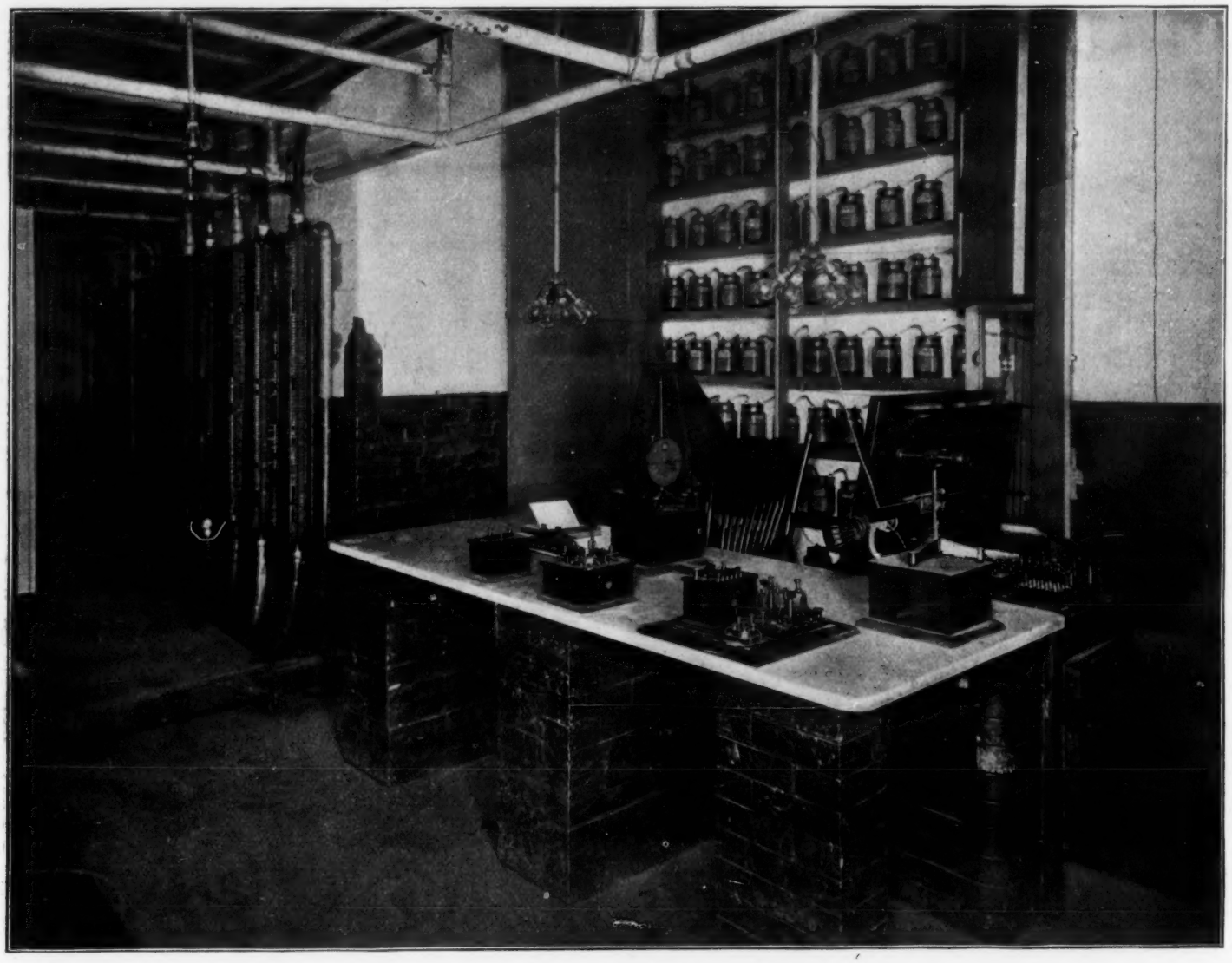


FIG. 4.—TESTING OUTFIT IN TERMINAL ROOM.

In order to fully appreciate the workings of the Kinloch Telephone Company's switchboard and understand its meritorious features, it may be well to direct attention to some of the essential differences between the multiple system of the Bell Company and the modification of the multiple system as devised by Mr. M. G. Kellogg.

In a central exchange operating the multiple system, a subscriber's call is completed by the same operator who receives it, without an intermediary or trunking operator, as employed in a divided board. The switchboard is subdivided into sections, each section consisting of three operators' positions and provided with the requisite apparatus, such as transmitters, receivers, calling and listening keys, plugs and cords for establishing connections between subscribers. Each section contains, in addition to a definite number of "answering jacks" representing incoming lines, the "multiple jacks," one for

each line in the entire exchange. Each operator not only takes care of the lines in front of her, but she may reach to either side and overlap one-third of the adjacent sections, while the middle operator can control the entire section. By means of this arrangement it is only necessary to multiple the line jack of each line for every third operator's position. Even then practice has demonstrated that in an exchange equipped with 2500 lines the spring jacks of each line would have to be multiplied ten or twelve times; with 5000 lines they would be multiplied twenty or more times, with 10,000 lines about fifty times, and with a patronage of 20,000 subscribers in the exchange, about one hundred times.

Thus it will be seen that the cost per subscriber's line increases at an enormous rate as the number of lines in the exchange increases. The enlargement of a single board of this type is further limited from the fact that it is impossible to concentrate more than 10,000 jacks within reach of the average operator, nor would it be at all possible for the operator to handle more than 5000 or 6000 multiple jacks efficiently. It therefore becomes prohibitive to enlarge any one ex-

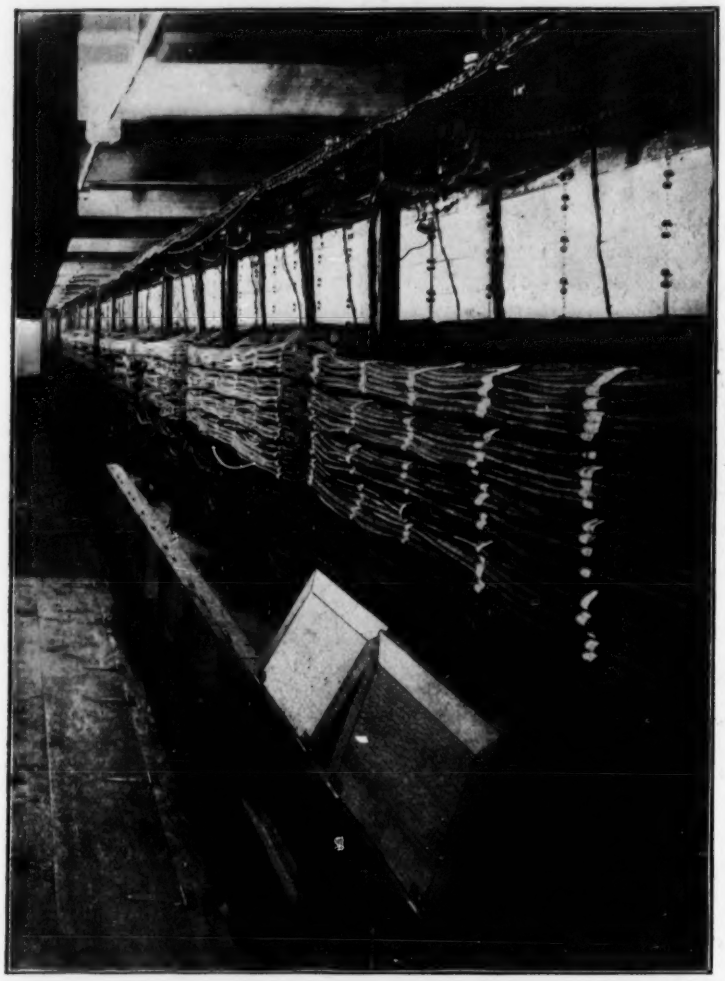


FIG. 5.—REAR OF ONE SECTION OF ONE SIDE OF THE BIG SWITCHBOARD.

change operating the multiple system beyond about 6000 lines. In practice when such limit is approached it is customary to relieve the central exchange by dividing the lines into several branch exchanges connected together by trunking circuits. Each branch exchange means another set of operators, to whom is transferred a call originating in one exchange centre intended for a subscriber located in another exchange centre. In such cases a message is handled by two operators before connection is established, thus offering opportunity for delay and error, while special apparatus must be installed for trunking between the branch exchanges. The efficiency of service is therefore greatly reduced, compared to a system in which all lines enter one exchange. In some of our large cities, where more than four branch exchanges are operated, it is found that more than 90 per cent. of the connections require trunking, and the number of operators is therefore increased about twofold over that where the trunking feature is eliminated.

The Kinloch Telephone Company has installed in its exchange the Kellogg "divided exchange multiple switchboard system." This system embodies all the good qualities of the multiple switchboard and introduces such additional improvements as to make it feasible to bring all lines to one central exchange. All subscribers' lines are divided into four divisions, designated as *A, B, C* and *D* lines, respectively. The multiple switchboard is divided into four corresponding divisions, *A, B, C* and *D*. Each division consists of ten sections, with three operators' positions per section. Each section has in multiple one-fourth of the total number of lines entering the exchange. Thus each *A* subscriber's line appears at a terminal called a "spring jack," on every section belonging to the *A* division. In the same manner each *B* subscriber's line appears at every section of the *B* division, each *C* subscriber's line appears at every section of the *C* division, and each *D* subscriber's line is multiplied throughout the *D* division. These spring jacks are called "multiple" or "outgoing jacks."

The exchange is at present wired and equipped for 8800 subscribers. Thus each section of each division of the switchboard has 2200 outgoing call jacks, or one-fourth of the total number of lines entering the exchange. In addtion to the multiple jacks, each division contains "incoming call jacks" equivalent to the entire number of lines. Each of the ten sections per division will, therefore, be equipped with 880 jacks, representing the incoming lines. Located in a tier immediately below the incoming call jacks and corresponding in position to them are polarized annunciators, or drops, each representing an incoming line and responding when a subscriber signals to the operator for a connection. A drop for every line appears in each of the four divisions of the switchboard. In the lowest tier before each operator are the "clearing-out drops" intended to signal the operator for disconnection. Each drop corresponds to a pair of plugs and cords. A complete equipment of a section, consisting of three operators' positions, will therefore include three transmitters, three receivers, thirty pair of plugs and cords, thirty ringing keys, thirty listening keys, 880 incoming call jacks, 880 polarized annunciators, thirty clearing-out drops, 2200 multiple or outgoing call jacks and a supervisory pilot lamp to readily attract the operator's attention. It will be seen therefore that an operator in any one section may connect any one of 880 incoming lines with any one of 2200 outgoing lines in that division.

The subscribers' station apparatus of each line is equipped with a magneto generator and four keys with commutator springs and connections for operating any one of four annunciators at the exchange switchboard. The four buttons or keys are designated by the four letters *A, B, C* and *D*, respectively. These correspond to the four divisions of the switchboard, in each of which is located one of the four drops that responds to one of the four keys, when depressed by the subscriber. This results from the fact that current of either polarity may be sent from the subscriber's local ground over one side of the metallic circuit line, which is normally grounded through two of the polarized drops at two divisions of the switchboard. These drops are so connected into the circuit that one responds to a current of only one polarity and the other is alone sensitive to the opposite polarity. The other two drops at the switchboard are normally bridged across the two sides of the metallic line, and when either of the other two keys at the subscriber's instrument are depressed, current of one polarity and that only will cause the third drop to indicate, and current of the opposite polarity will operate the fourth drop. Thus each line entering the exchange has four polarized drops, so constructed that each will indicate a call when a current of one polarity passes through it in a given direction, but will not act when a current of opposite polarity passes.

The circuit diagram (Fig. 3) represents the circuit connections and apparatus of 6 lines entering the exchange, including the incoming and outgoing call jacks and the polarized drops of the lines. The respective positions of the four divisions of the switchboard, with sections in each, are also indicated diagrammatically. The six lines chosen are A-1, B-441, B-442, C-441, C-881 and D-1321. The local connections of only one line (A-1) to its relay magnet and the connections of the polarized drops of only that line are shown. Similar connections for the similar apparatus of the other lines may be readily inferred, as the circuits show to better advantage without a duplication of them. The connections and arrangement of other apparatus of the other lines of the exchange will be evident from this figure. The operator's test circuit diagram (Fig. 2) is shown and is similar to the ordinary diagram used for this purpose.

The operation of completing a subscriber's call through the switchboard may be briefly described as follows: When a subscriber desires to connect with the line of any other subscriber, he communicates with the operator at the division of the switchboard cor-

responding to the alphabetical designation of the number of the desired subscriber by depressing the key of the same letter at his instrument, thus causing the drop of the line at that division to indicate. As soon as the operator observes the call she immediately inserts the switch plug in the answering jack corresponding to the indicated drop and communicates with the subscriber by throwing over the listening key, thus bridging across the line. On receipt of the number desired a busy test is made by the operator by touching the ring of the multiple jack with the tip of the calling plug. If the line is "clear" the operator receives a click in her head phone, but if "busy" no click is obtained. If the latter condition prevails the operator notifies the subscriber that the line desired is busy. Should the line be clear the operator immediately inserts the mate of the first plug, "the calling plug," into the multiple jack of the designated number and the called subscriber is signaled by ringing his bell with the proper ringing key.

When conversation between the subscribers has ended and the receivers are replaced on their respective hooks, the first party or calling subscriber gives a disconnect signal to the operator by depressing

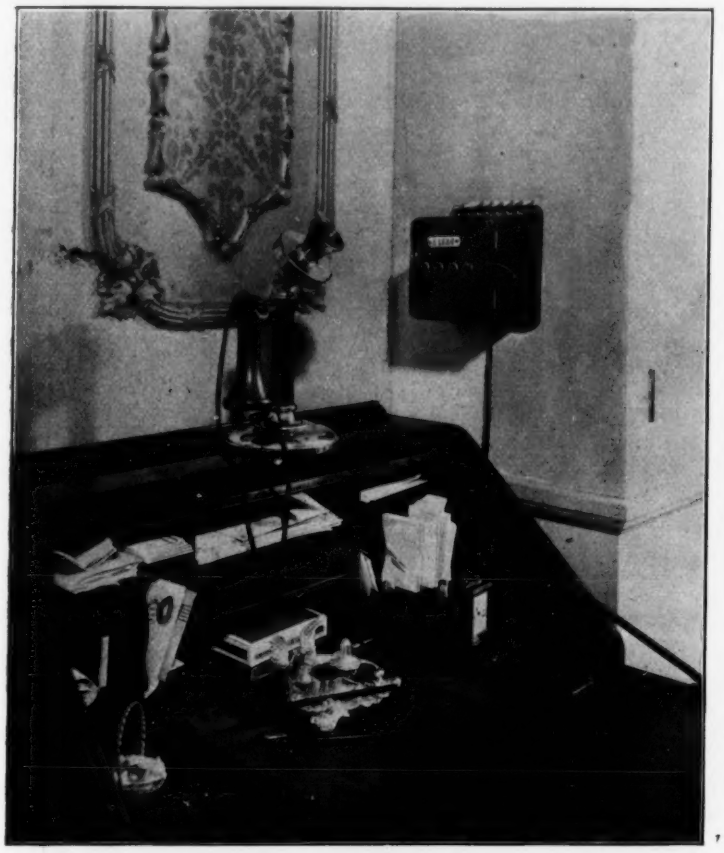


FIG. 6.—SUBSCRIBER'S INTERCOMMUNICATING SET.

any one of the four keys at the subscriber's station, thereby causing a clearing-out drop to indicate. When the operator observes this, the plugs are immediately removed and both lines cleared for further use. A supervisory system of automatic calling and clearing-out signals, so that by the mere act of depressing the proper key or button, the operator is automatically signaled and the subscriber relieved of any further work in this connection, has been contracted for by the company and will be installed early in 1900. By the mere act of replacing his receiver on the hook, each subscriber automatically signals to the operator that the conversation is ended. The operator's plugs may then be removed and the lines cleared at once.

The switchboard, as at present installed, is fully equipped for 8800 lines. Nine sections of each division are in operation with two operators per section, ten hours per day, giving service to about 6000 subscribers. Connected with each division of the switchboard is a monitor, who is in charge and responsible for the prompt connections by the operators of her division. She can at all times cut in on the lines and ascertain how efficiently the operator handles the work. In addition to the four monitors, a chief operator has supervision of the entire board and is at all times prepared to give information to, or receive complaints from, subscribers. The switchboard is so designed that each of the four divisions may be equipped with 5,040 lines, giving the entire exchange a capacity of 20,160 lines. The Kellogg "divided exchange system" thus not only offers all advantages of the multiple switchboard type, universally recognized by the telephone fraternity, but it enlarges on the principles of construction so that it will accommodate the work of four times its previous capacity.

It is therefore noteworthy that in a telephone exchange with 20,000 subscribers in service, at some future time, no single connection will require the assistance of more than one operator, dispensing with all branch exchanges and trunking between operators.

It is not intended in the scope of this article to enter into the dedetails of construction and engineering problems which necessarily arise, nor to discuss the method of organization and operation of an enterprise of this character.

The following is a brief recapitulation of the principal items and manufacturers concerned in the construction of the plant and system: The Kellogg Switchboard and Supply Company of Chicago furnished all the switchboard apparatus. The Electric Storage Bat-

FIG. 7.—DESK SET AND WALL TELEPHONE SET.

tery Company supplied the chloride accumulators. The American Electrical Works, Providence, R. I., supplied all the shaft cables in the building. The Sterling Electric Company of Lafayette, Ind., supplied all the terminal heads in the terminal room, as patented by Mr. Frank B. Cook. The same company also supplied all the protecting devices. The Standard Underground Cable Company, Pittsburg, Pa., made and installed all the underground cables and furnished also the small cable heads. The General Electric Company installed the isolated plant for lighting and telephone work, and the Crocker-Wheeler Electric Company furnished all the ringing and charging generators. John A. Roebling's Sons Company of Trenton, N. J., furnished all the messenger wires and cable hangers. Mr. John T. McRoy furnished and laid the extensive system of vitrified clay conduits.

The brilliant success of the company is doubtless due to the excellent personnel of the organization. The work of the engineering department, under the able direction of Mr. Chas. H. Ledlie, chief engineer, deserves the highest mention and reflects great credit upon its engineers. It has at every step met all requirements necessary to an efficient working telephone system.

The officers of the company are men who have been connected with other large interests, while the directors are representative of the city's large commercial institutions.

The officers are: Sam M. Kennard, president, Wm. F. Nolker,

first vice-president; Wm. D. Orthwein, second vice-president; Breckinridge Jones, treasurer; Hopkins J. Hanford, general manager; Charles H. Ledlie, chief engineer and assistant general manager; H. Linton Reber, secretary and assistant chief engineer; Boyle, Priest & Lehmann, counsel. Board of Directors: S. M. Kennard, Wm. F. Nolker, Wm. D. Orthwein, Breckinridge Jones, Hopkins J. Hanford, C. K. Dickson Walsh, Adolphus Busch, Ellis Wainwright, Julius S. Walsh, Chas. H. Turner, C. Marquard Forster, August Gehner and Geo. J. Kobusch.

The Terminal System and Underground and Aerial Lines of the Kinloch Telephone Company.

BY FRANK CLARK COSBY.

The terminal room of the telephone exchange is located in the basement of the building in order to allow the incoming underground cables to terminate directly in their respective heads. The room is directly under the sidewalk, is finished throughout in white enamel, making it very light, and unusual precautions have been taken to make it absolutely dry. At first it was found that moisture seeped in from the street through the heavy rock walls under certain conditions, and to prevent this an inner wall was built of clay tiling, and plastered, this wall being built out about three inches from the outer wall, leaving an air space all around, the base being properly guttered to carry off to the sewer any water that might enter. This method has been found to be most satisfactory, but unfortunately another trouble arose due to the proximity of the terminal room to the engine and boiler rooms of the building, as the heated air from the latter caused "sweating" on all of the metal parts of the former. This was nicely remedied by a careful system of ventilation and the painting of all parts possible, four or more coats being applied.

As the terminal room is the "trouble" and testing station, on account of the facility with which any subscriber can be reached and the trouble at once located either in the line or in the exchange, the testing instruments are permanently set up here. This outfit is about as complete as it can be made, and no expense has been spared in its equipment. The galvanometer has been mounted on a separate stone and brick foundation so that it is free from the vibrations of the building. The Wheatstone bridge, a very large one, is in a quartered oak drawer so that it can be easily put in use when wanted, and is out of the way at other times. The condenser, resistance box, shunt, charging and discharging key and all kindred apparatus are conveniently at hand and can be used by the tester without changing his position; when not in use, all instruments are covered by oak cases to protect them from dust. The battery used consists of 100 cells of the Leclanche type, giving a constant voltage of 160 volts when all are in service, or any fraction of that as desired, the change being effected by a switch. These cells are tested frequently, so that constant voltage is assured, and are placed in a shelf or cupboard, out of the way. (Fig. 4.)

TERMINAL SYSTEM.

The terminals installed were made by F. B. Cook, of Chicago, and

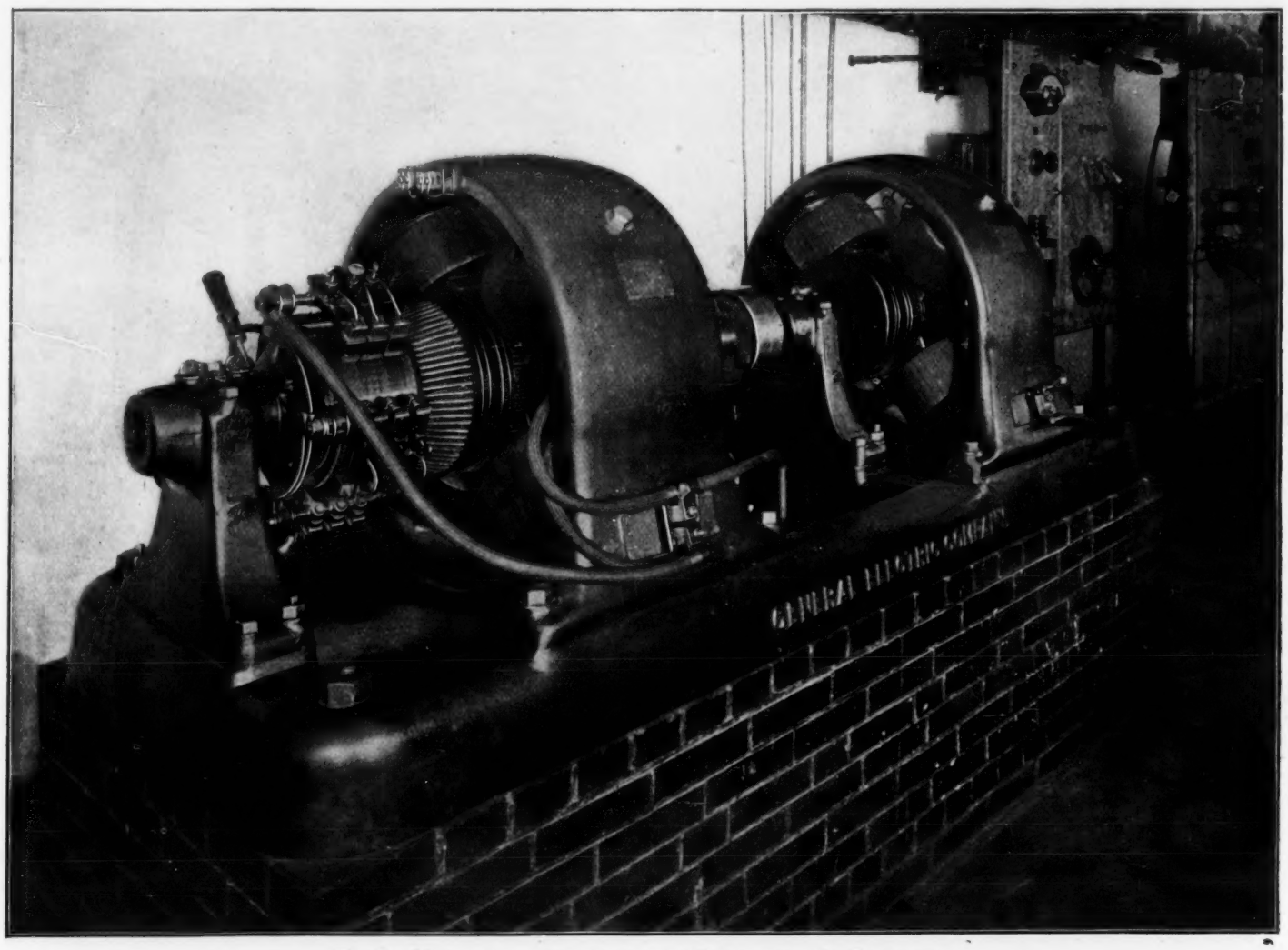


FIG. 8.—MOTOR-GENERATOR PLANT FOR EMERGENCY—IN BASEMENT.

are what are commonly known as "Conference terminals" for 100 pairs of conductors. They contain a double row of 102 binding posts on each side, the two extra posts being for spare wires, set into the iron body of the terminal with hard rubber bushings for insulators. The underground cable comes into the base of the terminal through an opening left for the purpose. Moisture is kept out by a wiped joint between the lead sheath and a brass nipple that screws into the opening. The cable is then "formed," i. e., a pair being taken out on each side nearest the bottom and cut off so that it will fit nicely into the binding post, then the next ones taken out, and so on up to the top; at the bottom of the terminal the cable is thickest, having its full diameter of the core. This gradually tapers off as the successive pairs are taken out, until the last pairs are reached. (See Supp.)

A pair of notched boards are used for forming, and while the cable is still in the form it is laced with a waxed thread which keeps it in shape permanently The individual wires are then soldered into

the binding posts by means of a small electric soldering iron (the posts come already tinned), care being especially taken to get the right side of the pair into the proper post. A brass strip is screwed onto the outside of the terminal numbered from 1 to 51 on the left side, beginning at the top, and 52 to 102 on the right side, a number appearing between two posts. The posts are slightly staggered and the upper one of each number is always used for the same side of a pair; in this system the upper wire is called positive, and as each pair consists of wires with two colors of insulation, magenta and blue, the magenta wire is called the postive of the pair and the blue the negative, so that in soldering in the formed cable, the magenta-insulated conductor is always put into the top binding post of the pair. The second row of binding posts is for the cable going to the distributing board which comes in from the top of the terminal, and

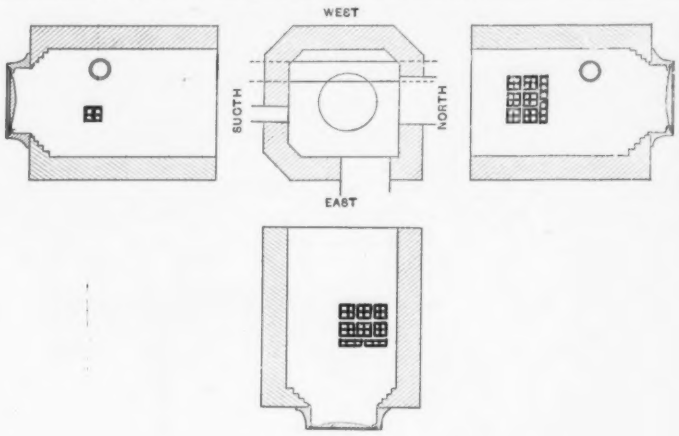


FIG. 9.—MANHOLE AND SUBWAYS, SECTIONAL VIEW.

is formed, laced and soldered in precisely the same manner as the underground cable, except that it begins at the top and gradually tapers off as it goes down.

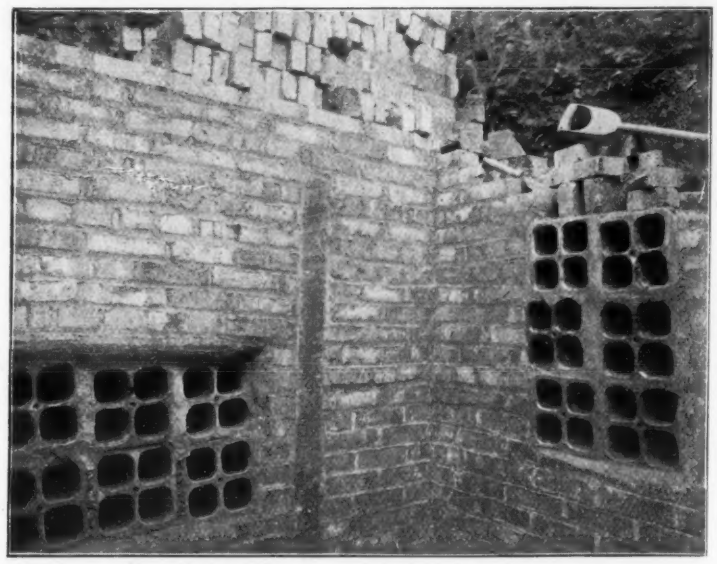


FIG. 10.—MANHOLE IN CONSTRUCTION SHOWING DIFFERENT GROUPINGS OF VITRIFIED CONDUIT.

The body of the terminal is an open cast-iron box. A brass cover is screwed on after the cables have been properly connected, which cover rests on a rubber gasket to exclude moisture and has a number plate by which to identify the terminal. The binding posts containing the wires of the underground cable or line, are connected to those containing the wires going to the distributing board through a heating coil and a lightning arrester. The heating coil connects two springs, so that when a small current is in the circuit the coil fuses after a short time and releases these springs, one of which grounds the underground line and the other opens the line to the distributing board. Whenever a line becomes grounded in the terminal room, through the fusing of the heating coil, it rings a call bell notifying the attendant there of the fact and also registers the number of the terminal by means of an ordinary annunciator board, so that the trouble is readily found and fixed.

Attached to one of the springs of the heating coil, but not in a circuit, is a lightning arrester consisting of two carbon plates with a sheet of thin oiled silk between them. When a discharge occurs, the silk becomes charred, which grounds the line, and as the heating

FIG. 11.—METHOD OF LAYING MC ROY CONDUIT.

coil fuses at the same time, both are replaced at once, and the line is again ready for service. Both the lightning arresters and heating coils are on the outside of the terminal, where they can be gotten at most readily. There are at present 88 of these terminals in use here, which will accommodate therefore 8800 subscribers.

UNDERGROUND SYSTEM.

The underground system of distribution is rather unique in that it is what might be termed a direct system as distinct from the usual multiple system as commonly adopted. In a multiple system

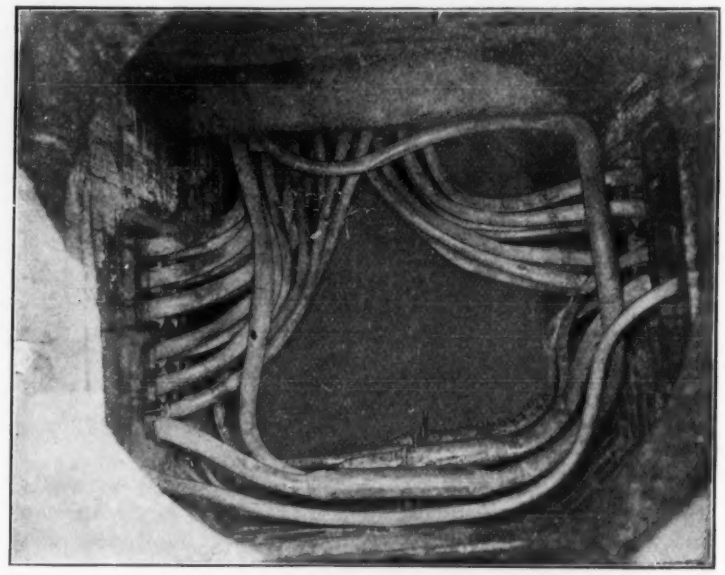


FIG. 12.—LOOKING DOWN INTO MANHOLE; STRAIGHT AND RIGHT ANGLE CABLE RUNS.

the separate pairs of a cable go to two or more terminals, the idea being that if one terminal becomes overcrowded due to an unlooked for and abnormal increase in subscribers, the pairs which are multipled out can be used without going to the necessity of putting in a new cable; but these pairs must then be cut out of the other terminals. It is assumed that the increase will not occur in the localities where both terminals are situated, and a decrease in one can be used for an increase at another, if this fact is borne in mind when the layout of the cables is planned.

In the "direct" system, so called for want of a better name, each pair in a cable goes to one and only one terminal, and when a terminal is full and another subscriber is to be accommodated there, it is necessary to connect up a new cable. This is provided for, however, in the original layout where a 100-pair cable may end in a 100-pair terminal of which only 50 pairs are to be put into immediate use, the remaining 50 pairs being left for the increase due to new subscribers, thus obviating the laying of a new cable. The percentage of increase is of course not constant and varies entirely with the locality; the business district being expected to show the greatest development, and this development depending upon the tendency of the city to grow and expand in certain localities.

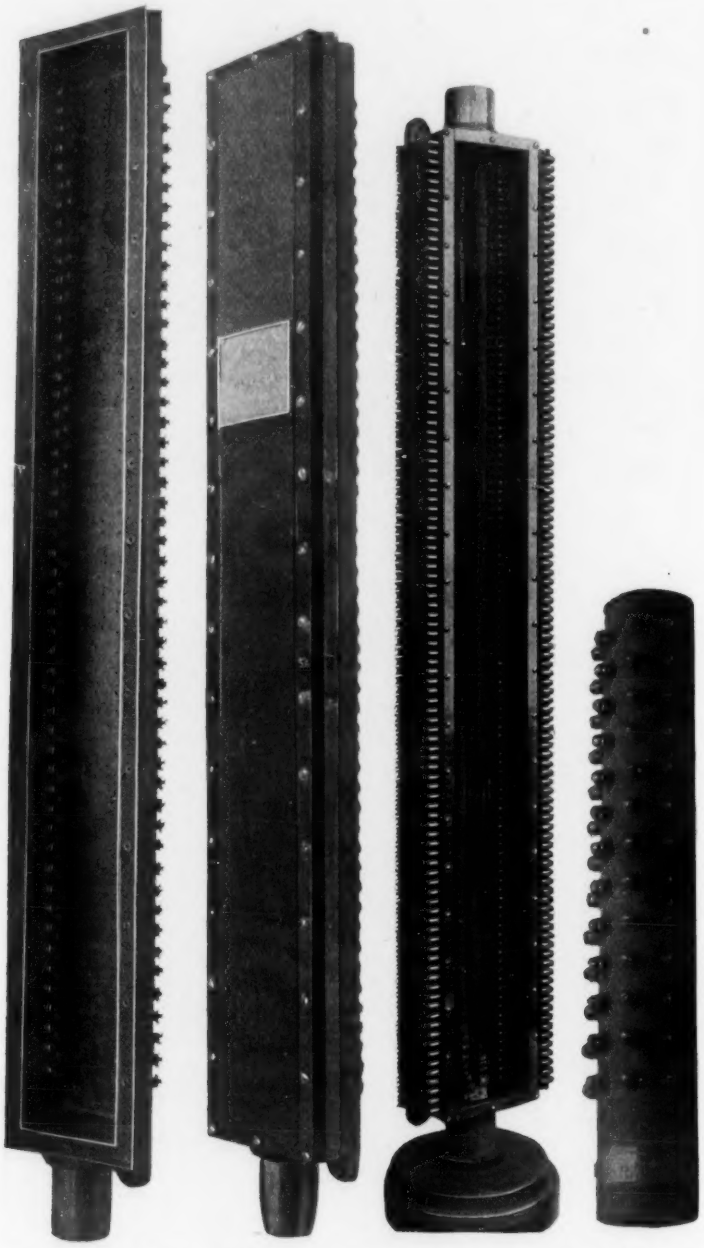


FIG. 13.—TUBULAR HARD RUBBER AND IRON DOUBLE ROW LOCK NUT CABLE TERMINALS.

As regards the cables themselves, they are of the best that can be made for underground purposes, and were supplied by the Standard Underground Cable Company, of Pittsburg, Pa. The specifications upon which the cables were made called for the following:

Conductor.—Each conductor shall be of soft copper and of such size and conductivity as will insure, at all seasons of the year, a conductor resistance of not more than 45 ohms for each mile of cable, after the cable has been laid and spliced.

Core.—Each conductor shall be insulated with two wrappings of paper, put on in reversed layers, or an equivalent. The paper on one wire of each pair shall be colored distinctively. The conductors thus insulated shall be twisted in pairs, the twists being regular and uniform, and not less than 2¾ inches nor more than 3¼ inches in length. The conductors thus insulated and twisted shall be formed into a core arranged in reverse layers, and thereover placed an overlapping wrapping of specially prepared paper. The ends of each length shall be filled with the best quality of white wax paraffine which shall not interfere with the distinctive coloring, to prevent the entrance or circulation or air in the cable. This insulating material must seal the cable for a distance of at least two feet, and not more than ten feet on each side of the joint, after the joint has been made. After the ends of the cable have been filled with this insulating material, the ends of the lead sheath must be soldered up so as to seal the cable hermetically.

Sheath.—The core shall be enclosed in a pipe composed of commerically pure lead. This pipe shall be formed around the core, and have a thickness of ⅛-inch for 100 pair, and uniformly decreasing to 3-32-inch for ten pair, the sheath being concentric and of uniform thickness throughout its length. The pipe shall be free from holes and other defects.

Electrostatic Capacity.—The average electrostatic capacity shall not exceed .080 of a microfarad per mile, each wire being measured against all the rest and the sheath grounded, after the cable is laid and connected. The electrostatic capacity of any wire so measured shall not exceed .085 of a microfarad per mile. These measurements to apply at a temperature of 60 degs. Fahrenheit.

Insulation Resistance.—Each wire shall show an insulation resistance of not less than 500 megohms per mile at 60 degs. Fahrenheit,

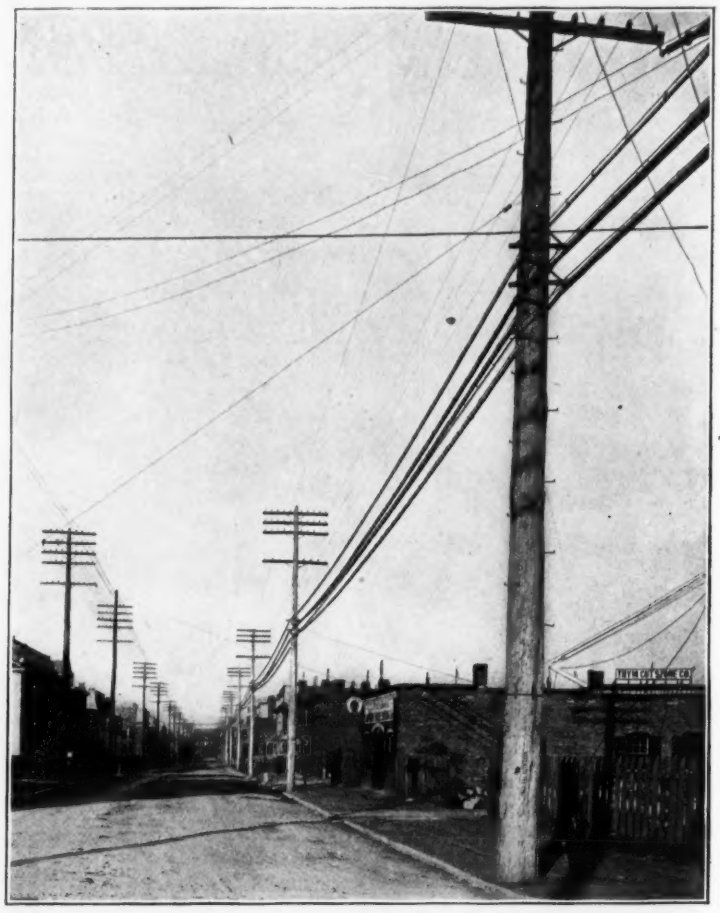


FIG. 14.—A POLE LINE WITH SINGLE WIRES ABOVE, CABLES BELOW.

when tested at the factory of the contractor in the usual manner, and when laid and jointed by the contractor shall have an insulation resistance of not less than 250 megohms per mile, each wire being measured against all the rest and the sheath grounded.

Guarantee of Electrical Conditions.—The electrostatic capacity shall not increase, nor shall the insulation decrease beyond the limits above specified, for three years after the cable has been laid and jointed, except from mechanical or other injury through no fault traceable to the contractor.

Of the underground cable there was in all about 390,000 feet put in, the principal sizes being 100, 75, 50, 25, 15 and 10 pairs, together with odd sizes, and some 200-pair cable, as mentioned later on. This cable was installed by the manufacturer in McRoy multiple duct laid by the St. Louis Electric Construction Company, and went in absolutely without a hitch of any kind. It was a cause of congratulation and comment that so large an installation was put in so suc-

cessfully, and comparatively with no trouble and delay, except that incidental to any large undertaking.

In installing the cable a manhole capstan built for the purpose was employed, and an average of 3500 feet a day of 100-pair cable was put in. This capstan consisted of an 18-inch drum on a 12-foot steel shaft, with a key and nut so that its height could be regulated, so as to bring the middle of the drum opposite the duct into which the cable was to be pulled. The shaft fitted into a socket in a bottom board braced against the sides of the manhole, and ran through an iron guide on the surface, which guide consisted of two cross-pieces of flat iron, long enough to span the manhole frame, and having holes in them by which it could be securely pinned to the street. A collar with protruding spokes is slipped over the top, and the height

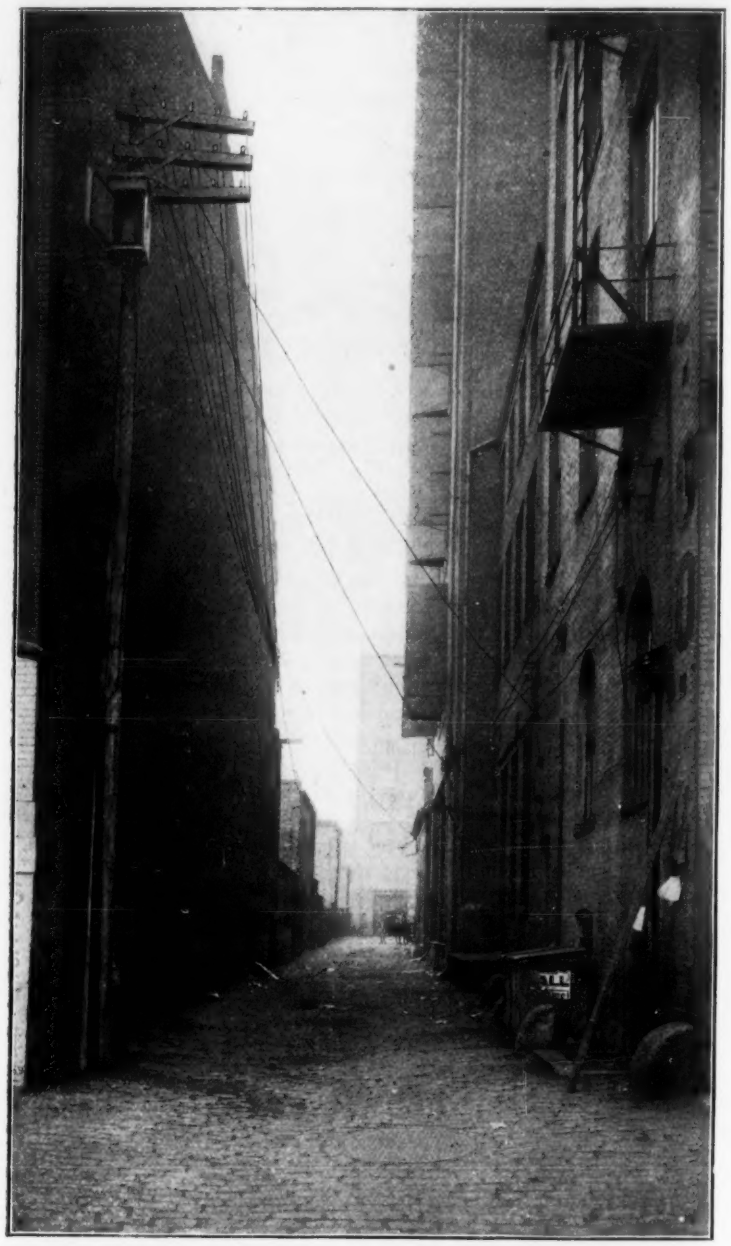


FIG. 15.—METHOD OF DISTRIBUTION IN ALLEY FROM CABLE HEAD.

regulated by a key and bolt, and iron pipe handles are slipped onto the spokes and serve as capstan bars for the men to push on. This apparatus is easily moved, and was found most serviceable, especially where small manholes were encountered.

It was with such an apparatus, and an ordinary gang of nine laborers and a foreman, that what is believed to be a record run was made, over 7500 feet of 100-pair cable and larger size in 8½ hours. In order to accomplish this the conditions must be perfect, long straight runs, not too frequent changing of the capstan, and, above all, a well drilled gang, every man of which knows what he is to do and does it without being told. Such conditions do not often arise, so that a daily average of 2500 to 3000 feet of 100-pair cable is considered very creditable.

The installation of the cables was begun in the fall, and carried through the winter, the jointing gang following up the pulling-in gang as closely as possible. On account of the sheath of the cables being soft, great care had to be taken to keep them from kinking. On the other hand, it was possible to bend them properly around the walls of the manholes, even when the manholes were quite small, and in a number of cases, cables were put in when they had to make a right-angled turn, no splice being made. The pliability of the cables also enabled their being pulled through intervening manholes, when the distances were short, and the difference in level and alignment of the ducts was not too great.

The splicing was done in the usual manner, except that where the 100-pair mains branched off into smaller subsidiary cables it was sometimes necessary to make three-way, four-way and even five-way splices. These subsidiary cables ended in a terminal either at a pole in an alley or else in the basement of a building, so that all the laterals were comparatively short. Where the terminal was in an alley, the house connection was made by means of Marsh duplex wire, which consists of two No. 14 B. & S. conductors of hard-drawn copper, one insulated with rubber compound, and the other with high grade weatherproof insulation, and the two twisted together. When the terminal was located in the basement of a building, rubber covered braided wire was used for connection to the instruments.

The terminals used were of the tubular hard rubber type for all sizes smaller than 10-pair, and of the well-known iron, double-row, lock-nut "Conference" style universally used by the telephone, telegraph and fire-alarm companies for 10-pair and larger sizes. In both styles the cable is connected to binding posts on the inside of the terminal by means of a lock-nut connection, and the line wires to the same binding posts on the outside of the terminal, the terminal in any event being enclosed in a weatherproof box. As a further precaution against moisture, all the small tubular terminals after they were connected up and the lines tested were filled with insulating compound. Both these styles of terminals are so well known as to need no further description, and were furnished and installed by the cable manufacturer. (Fig. 13.)

AERIAL LINES.

The cables for the overhead lines were furnished for the Kinloch Telephone Company by the Standard Underground Cable Company, and were installed by the St. Louis Electric Construction Company, which also built the conduit system, putting in a system that it would be hard to surpass anywhere in the United States. The poles are of well seasoned white cedar averaging 48 feet in height, with 6 feet in the ground, and have a minimum diameter of 7 inches at the top. The cable cross-arms are of 3-inch angle-iron placed low upon the poles, and hold the iron messenger wire by means of U-bolts. The diameter of this messenger wire varies with the size of cable to be suspended, ranging from ½-inch for 100-pair to 5-16-inch for 25-pair cable. On account of the rigid inspection to which the poles were subjected before being accepted, and the care with which they were placed in the ground, their overhead lines are perfect as regards alignment and uniformity, the lines being absolutely straight, of an even height, and as taut as desirable. The poles are braced in all directions against strains by means of galvanized iron guy wires and anchor rods.

The ordinary lines are of hard-drawn bare copper wire, of No. 12 B. & S. G., erected and insulated in the usual manner, of which about 3800 miles have been strung.

The overhead cables are similar in all respects to those put in underground, except that they are made of No. 20 B. & S. conductors instead of No. 19 B. & S., and the thickness of the lead sheath is slightly reduced—both of these changes were made in order to lessen the weight. They are required to fulfil the electrical requirements and tests specified for the underground cables. Only four sizes are made use of, 100-pair, 75-pair, 50-pair and 25-pair, and of the four about 499,000 feet in all have been strung, including the lines crossing the river, and those in East St. Louis, Ill.

After the original installation had been completed an abnormal increase of subscribers developed, and in order to accommodate these it was necessary to put in eight additional mains in the underground district. This was provided for by four 200-pair cables, essentially the same as the others, except as regards the requirements for electrostatic capacity. Of this size cable about 18,000 feet was installed in the underground district, connecting with eight 100-pair cables in the outlying district.

From the foregoing it will be seen that in so far as materials and requirements are concerned, the Kinloch Telephone Company, of St. Louis, is undoubtedly the equal of any telephone company in the country.

The Rotary Phase Converter.

BY PROF. R. W. QUICK.

THE machine known as the rotary converter and used to convert a polyphase current into a continuous current, or *vice versa,* has been the subject of more or less careful study for some time past. Its characteristics are now well known, having been worked out from the theory and the results subjected to experimental test. But as far as the writer is aware, nothing has been written on the behavior of this machine when used simply as a phase converter. This subject offers an interesting field of study, the partial results of which are given in this article.

We will first investigate the heating effect in an armature of a bipolar machine used to convert an *n*-phase to an *m*-phase alternating current. It is simpler to take the general case at first and after determining our equations, supply particular values to *m* and *n* to meet the cases that might occur in practice.

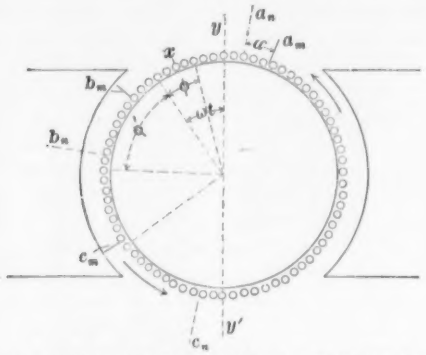
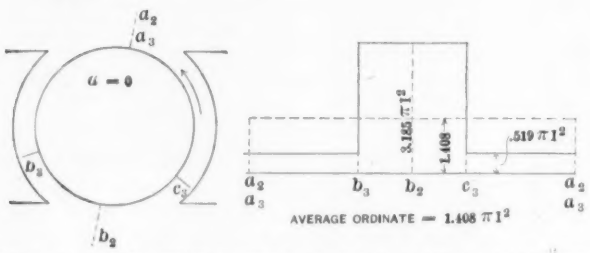


FIG. 1.—ARMATURE ROTATING IN A BIPOLAR FIELD.

In Fig. 1 is represented an armature rotating in a bipolar field separately excited; a_n b_n c_n .. are the *n*-phase leads connected to *n* equidistant points on the armature winding, while a_m, b_m c_m .. are the *m*-phase leads connected to *m* equidistant points on the winding, the outer ends being connected to slip rings. The angular distance between one of the *m*-phase leads a_m and the nearest *n*-phase lead is *a*. Time will be reckoned from the moment when the midpoint of coil a_m b_m is at the neutral point *y*.

Let E_m = maximum e. m. f. between any pair of the *m*-phase leads.
E_n = maximum e. m. f. between any pair of the *n*-phase leads.
E_o = maximum e. m. f. between any slip ring and the neutral point of the system obtained by supposing each slip ring joined through a very high resistance to a common junction. the neutral point E = the continuous e. m. f. which would be produced at a commutator supposing it were supplied to machine.



FIGS. 2 AND 3.—DISTRIBUTION OF HEAT AROUND ARMATURE.

I = one-half of the supposed continuous current which would represent the equivalent power of the alternating input.

Now the actual instantaneous current in any conductor χ between leads a_n b_m will be the difference between the instantaneous *n*-phase current of the winding a_n b_n and that of the *m*-phase current of the winding a_m b_m the former being input and the latter output. Hence if i_n and I_n represent the instantaneous and maximum values respectively of the *n*-phase current in conductor x, we have

$$i_n = I_n \sin \omega t$$

assuming no lag of the current in either phase, and likewise,

$$i_m = I_m \sin (\omega t - \phi)$$

where i_m and I_m are the respective instantaneous and maximum values of the *m*-phase current in conductor χ, and ϕ is the phase difference of those currents (see Fig. 1). Hence the actual instantaneous current in χ conductor is

$$i = I_n \sin \omega t - I_m \sin (\omega t - \phi) \ldots \ldots \ldots \ldots (1)$$

It is desirable to compare the heat produced in the phase converter with that which would be produced if a commutator were supplied and machine were acting as a direct current generator. Hence we will reduce I_n and I_m to terms of the supposed continuous current I in the conductor χ representing equivalent output. Hence assuming a negligible loss and unity power factor

$$n \cdot \tfrac{1}{2} \cdot E_n : I_n = 2 E I \ldots \ldots \ldots \ldots \ldots \ldots (2)$$

And further since it will be seen from a little consideration that $E_n = 2 \sin \frac{\pi}{n} E_o$, from which $E = 2 E_o$ (by making $n = 2$) we have

$$I_n = \frac{4 I}{n \sin \frac{\pi}{n}}$$

and likewise

$$I_m = \frac{4 I}{m \sin \frac{\pi}{m}}$$

Hence the resultant current in x conductor is from (1)

$$i = I \left[\frac{4}{n \sin \frac{\pi}{n}} \sin \omega t - \frac{4}{m \sin \frac{\pi}{m}} \sin (\omega t - \phi) \right]$$

and if r is the resistance of each conductor the instantaneous rate of producing heat in conductor χ is

$$h_x = r I^2 \left[\frac{4}{\sin n \frac{\pi}{n}} \sin \omega t - \frac{4}{m \sin \frac{\pi}{m}} \sin (\omega t - \phi) \right]^2$$

and the average rate throughout a period will be

$$H_x = \frac{1}{T} \int_o^T h_x dt \ldots \ldots \ldots \ldots \ldots \ldots (3)$$

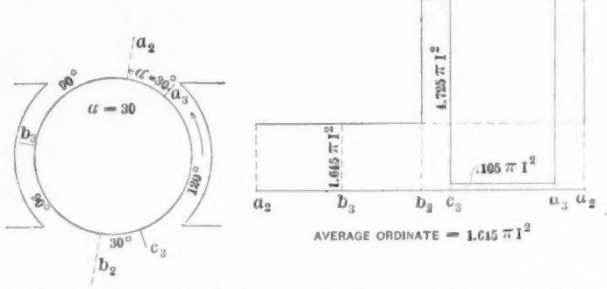
where $\omega T = 2\pi$. Hence substituting value of h_x in (3) and integrating gives

$$H_x = r I^2 \left[\frac{8}{n^2 \, s \, n^2 \frac{\pi}{n}} + \frac{8}{m^2 \sin^2 \frac{\pi}{m}} - \frac{16}{m \, n \, \sin \frac{\pi}{n} \sin \frac{\pi}{m}} \cos \phi \right] \ldots \ldots (4)$$

Now it is to be observed that the rate of producing heat in each conductor lying between a_n and b_m is the same, but that it is different from the rate in each conductor lying between b_m and b_n, because the heat depends on ϕ as seen from equation (4) and this angle becomes ϕ' (Fig. 1) in the expression for heat in each conductor between b_m and b_n. Consequently, to find the average rate of producing heat in the whole armature it is necessary to get separate expressions for the rate in each portion of the armature between consecutive leads and take the average of these rates for that or the whole armature.

We will now take up the cases most likely to arise in practice.

(1) Converting single-phase to three-phase or *vice versa*.



FIGS. 4 AND 5.—DISTRIBUTION OF HEAT AROUND ARMATURE.

In this case $n = 2$, and $m = 3$. From equation (4) and referring to Fig. 4 we have

$$\left.\begin{aligned}
H_{a_2 b_3} &= r I^2 \left[3.185 - \frac{16}{3\sqrt{3}} \cos (30 + a) \right] \ldots\ldots a \\
H_{b_3 b_2} &= r I^2 \left[3.185 - \frac{16}{3\sqrt{3}} \cos (90 - a) \right] \ldots\ldots b \\
H_{b_2 c_3} &= r I^2 \left[3.185 - \frac{16}{3\sqrt{3}} \cos (90 + a) \right] \ldots\ldots c \\
H_{c_3 a_3} &= r I^2 \left[3.185 - \frac{16}{3\sqrt{3}} \cos (30 - a) \right] \ldots\ldots d \\
H_{a_3 a_2} &= r I^2 \left[3.185 - \frac{16}{3\sqrt{3}} \cos (150 - a) \right] \ldots\ldots e
\end{aligned}\right\} \ldots\ldots (5)$$

To get the average, multiply righthand side of first equation by angular breadth $a_2 b_3$, which is $\frac{2\pi}{3} - a$, the second by $\frac{1}{3}\pi + a$, the third

by $\frac{1}{3}\pi - a$, the fourth by $\frac{2}{3}\pi$, and the fifth by a; then divide the sum by 2π, and after a few trigonometrical transformations and combining we have

$$H = r I^2 \left\{ 3.185 - \frac{16}{3} \left[\left(\frac{1}{3} - \frac{a}{2\pi} \right) \cos a + \frac{\sqrt{3}}{2\pi} a \sin a \right] \right\} \quad \ldots (6)$$

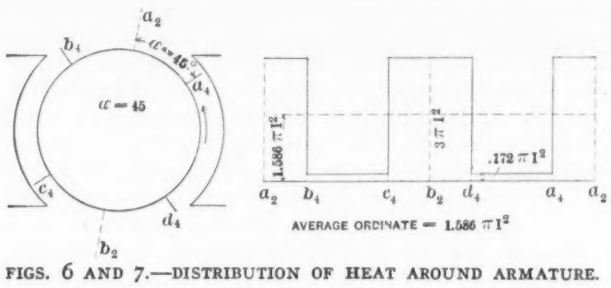
It is thus seen that since a is involved in the above expressions, the average rate of producing heat in the armature depends on the relative position of the leads. Examining (6) for maxima and minima we find that H is a maximum when $a = \frac{\pi}{3}$ and H is minimum when $a = o$. Substituting these values of a in (6) we find

$$H = 1.408\, r I^2 \text{ when } a = o$$
$$H = 1.645\, r I^2 \text{ when } a = 30^\circ$$

Furthermore, note that the heat generated per second in each conductor in the winding $a_2\ b_4$, for the case of $a = o$ is $0.519\ I^2$ (obtained from equation (5a) by making $a = o$); and that the rate of generation in $b_4\ b_2$, by using (5b), is $3.185\ rI^2$, thus giving about 6 times as much heat in winding $b_4\ c_4$ (see Fig. 2) as in the winding c_4, a_4, b_4. The distribution of heat around the armature for the case of $a = o$ is given in Fig. 3. The letters along the x axis correspond to the leads on armature with the relative positions as in Fig. 2.

For the case $a = 30^\circ$, using equations (5a-e), we see that the rate of producing heat in $a_2\ b_4$ and $a_4\ b_2$ is the same, and is equal to $1.645\ rI^2$; in $b_2\ c_4$ and $a_4\ a_2$ the rate is the same and is $4.725\ rI^2$; while in $c_4\ a_2$ it is only $0.105\ rI^2$. Fig. 4 exhibits the relative position of leads, and the heat distribution around the armature for this case, drawn to same scale as Fig. 3, is shown in Fig. 5.

From the above discussion we see that in converting from single-phase to three-phase, or *vice versa*, not only is the average production of heat around the armature for the relative position of leads shown in Fig. 2 less than that in Fig. 4, but the maximum rate in the former case is about 6 times the minimum rate, while in the latter case the maximum rate is 45 times the minimum rate. It is therefore very important that in this kind of transformation one of the single-phase leads should coincide with one of the three-phase leads, as shown in Fig. 2.



FIGS. 6 AND 7.—DISTRIBUTION OF HEAT AROUND ARMATURE.

(2) Converting single-phase to two-phase* or *vice versa*.

In this case $n = 2$, $m = 4$. From equation (4) and referring to Fig. 6, we have

$$\left.\begin{aligned} H_{a_2 b_4} &= r I^2 \left[3 - 2\sqrt{2} \cos (45 + a) \right] \ldots\ldots a \\ H_{b_4 c_4} &= r I^2 \left[3 - 2\sqrt{2} \cos (45 - a) \right] \ldots\ldots b \\ H_{c_4 b_2} &= r I^2 \left[3 - 2\sqrt{2} \cos (135 - a) \right] \ldots\ldots c \\ H_{b_2 d_4} &= r I^2 \left[3 - 2\sqrt{2} \cos (45 + a) \right] \ldots\ldots d \\ H_{d_4 a_4} &= r I^2 \left[3 - 2\sqrt{2} \cos (45 - a) \right] \ldots\ldots e \\ H_{a_4 a_2} &= r I^2 \left[3 - 2\sqrt{2} \cos (135 - a) \right] \ldots\ldots f \end{aligned}\right\} \ldots\ldots (7)$$

Referring to Figs. 1 and 6, and remembering that in the general case there will be 6 leads, ϕ will have the different values as given in above equations. Now getting the average rate of heat production by multiplying the first three equations respectively by $\frac{\pi}{2} - a$, $\frac{\pi}{2}$ and a (since the other half is symmetrical with the first half), adding together and dividing by π we have

$$H = r I^2 \left\{ 3 - 2\sqrt{2} \left[\frac{1}{\sqrt{2}} \cos a - \frac{\sqrt{2}}{\pi} a (\cos a - \sin a) \right] \right\} \quad \ldots (8)$$

Examining equation (8) for maxima and mimima we find that H is a maximum for $a = 45^\circ$ and a minimum for $a = o$; the respective values of H being:

when $a = 45^\circ$ $\quad H = 1.586\, r I^2$
when $a = o$ $\quad H = r I^2$

*In reality the so-called single phase is 2-phase, and the so-called 2-phase is 4-phase. But in this article the old nomenclature will be adhered to.

For the case $a = 45^\circ$, referring to Fig. 6 and using equations (7a, b, c), we observe that the rate of producing heat in winding a_2. b_4 and c_4, b_2, is $3\ rI^2$ in each; and that the rate in b_4, c_4, is $0.172\ rI^2$. The other half of armature being symmetrical the rates are the same respectively. The distribution around the armature is shown by the broken curve in Fig. 7.

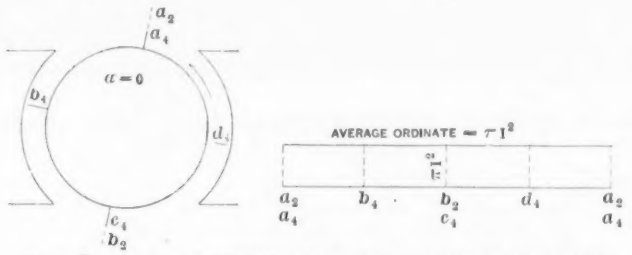
For the case $a = o$, and referring to Fig. 8, it is seen from equations (7a, b, d, e), that (equations c and f vanish) the rate of production of heat is the same in each portion of the winding, being equal to rI^2. The curve of distribution is therefore a straight line whose ordinate is rI^2 (see Fig. 9.)

We therefore conclude that in this transformation it is best to have the single-phase loads coincide with two opposite leads of the two-phase system, as being more economical and at the same time giving a perfectly uniform heat distribution around the armature.

(3) Converting two-phase to three-phase or *vice versa*.

In this case $m = 3$, $n = 4$. From equation (4) using the proper value of ϕ (see Fig. 10) we have

$$\left.\begin{aligned} H_{a_4 b_4} &= r I^2 \left[2.185 - \frac{8}{3}\frac{\sqrt{2}}{\sqrt{3}} \cos (15 - a) \right] \ldots\ldots a \\ H_{b_4 b_3} &= r I^2 \left[2.185 - \frac{8}{3}\frac{\sqrt{2}}{\sqrt{3}} \cos (75 + a) \right] \ldots\ldots b \\ H_{b_3 c_4} &= r I^2 \left[2.185 - \frac{8}{3}\frac{\sqrt{2}}{\sqrt{3}} \cos (45 - a) \right] \ldots\ldots c \\ H_{c_4 c_3} &= r I^2 \left[2.185 - \frac{8}{3}\frac{\sqrt{2}}{\sqrt{3}} \cos (45 + a) \right] \ldots\ldots d \\ H_{c_3 d_4} &= r I^2 \left[2.185 - \frac{8}{3}\frac{\sqrt{2}}{\sqrt{3}} \cos (75 - a) \right] \ldots\ldots e \\ H_{d_4 a_3} &= r I^2 \left[2.185 - \frac{8}{3}\frac{\sqrt{2}}{\sqrt{3}} \cos (15 + a) \right] \ldots\ldots f \\ H_{a_3 a_4} &= r I^2 \left[2.185 - \frac{8}{3}\frac{\sqrt{2}}{\sqrt{3}} \cos (105 - a) \right] \ldots\ldots g \end{aligned}\right\} \ldots (9)$$



FIGS. 8 AND 9.—DISTRIBUTION OF HEAT AROUND ARMATURE.

Getting the average rate of heat production by multiplying above equations respectively by $\pi/2$, $\frac{1}{6}\pi - a$, $\frac{1}{3}\pi + a$, $\frac{1}{3}\pi - a$, $\frac{1}{6}\pi + a$, $\frac{1}{3}\pi - a$, and a, adding, and dividing by 2π we have

$$H = r I^2 \left\{ 2.185 - \frac{8}{3}\frac{\sqrt{2}}{\sqrt{3}} \left[\left(\frac{\sqrt{2}}{6} + \frac{1}{6} \sin 15^\circ + \frac{1}{2} \cos 15 - \frac{a}{2\pi} [\cos 15 + \sin 15] \right) \cos a + a \sin a \left(\frac{2}{\pi} \cos 15 + \frac{\sqrt{2}}{4\pi} \right) \right] \right\} \ldots\ldots (10)$$

We find from equation (10) that H is a maximum when $a = 15^\circ$ and is a minimum when $a = o$; the values of H being:

when $a = 15^\circ$ $\quad H = 0.584\, r I^2$
when $a = o$ $\quad H = 0.527\, r I^2$

For the case $a = 15^\circ$, referring to Fig. 10, and using equations (9a....g), we find that the rate of heat production in winding a_4, b_4, in only $.008\ rI^2$ in each of windings b_4, b_3, and a_3, a_4, it is $2.185\ rI^2$, in each of b_3, c_4, and d_4, a_3, it is $0.3\ rI^2$, and in c_4, c_3, and e_3, d_4, it is $1.097\ rI^2$. The distribution around the armature of the heat evolved is exhibited in Fig. 11.

For the case $a = o$, referring to Fig. 12, and using the first six equations of (9), we have the heat in a_4, b_4, and d_4, a_3, $0.082\ rI^2$, in b_4, b_3, and c_3, d_4, $1.621\ rI^2$, and in b_3, c_4, and e_4, e_3, $0.645\ rI^2$. The curve of distribution of heat around the armature is shown in Fig. 13.

In the two-phase-three-phase conversion we therefore see that the generation of heat is less than in working as direct current generator, and that the relative position of the leads has little effect on the heat loss, the maximum being $.584\ rI^2$ and the minimum $.527\ rI^2$.

Below is a table exhibiting the heat losses for the different cases above considered. The loss for the continuous current of same output is taken as unity.

TABLE I.—HEAT LOSSES.

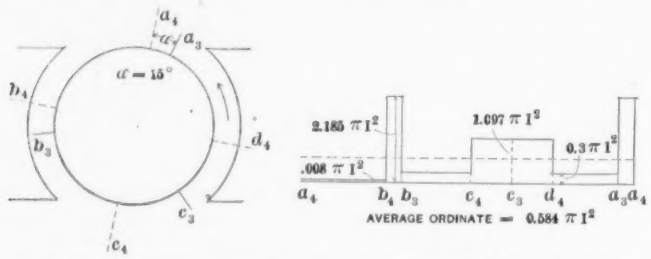
	Continuous Current.	Single-Phase to Three-Phase.		Single-Phase to Two-Phase.		Three-Phase to Two-Phase.	
		a		a		a	
Maximum average loss	1	30°	1.645	45°	1.586	15°	0.584
Minimum average loss.	1	0°	1.408	0°	1	0°	0.527
Maximum loss in a conductor.	1	30°	4.725	45°	3.0	15°	2.185
	1	0°	3.185	0°	1	0°	1.621
Minimum loss in a conductor.	1	30°	0.105	45°	0.172	15°	.008
	1	0°	0.519	0°	1	0°	.082

From the foregoing we see that in all the kinds of phase conversion considered, it is more economical to have one lead of one phase coincident with one lead of the other phase, not only because the average rate of heat production is less for this case, but because the maximum heat loss in a conductor is less. Further, note that only in the last case considered, namely, converting from two-phase to three-phase, is the heat loss less than when used as a continuous current generator.

It is to be observed that the above results are obtained on the assumption that there is no lag of the current in either of the phases. Also the curves of distribution of heat around the armature, as exhibited in Figs. 3, 5, 7, 9, 11 and 13, represent the rates at which the heat is *generated* in the conductors.

EFFECT OF CURRENT LAG.

To find the effect which a lag of the current in either the m-phase or n-phase system, or in both, has on the heat loss in the armature,



FIGS. 10 AND 11.—DISTRIBUTION OF HEAT AROUND ARMATURE.

we have to modify the equations accordingly. Introducing the power factor $cos\ \theta_n$ in equation (2) the value of I_n becomes

$$I_n = \frac{4\ I\ sec\ \theta_n}{n\ sin\ \frac{\pi}{n}}$$

and

$$I_m = \frac{4\ I\ sec\ \theta_m}{m\ sin\ \frac{\pi}{n}}$$

and equation (4) becomes

$$H_x = r\ I^2 \left[\frac{8\ sec^2\ \theta_n}{n^2\ sin^2\ \frac{\pi}{n}} + \frac{8\ sec^2\ \theta_m}{m^2\ sin^2 \frac{\pi}{m}} - \frac{16\ sec\ \theta_m\ sec\ \theta_n}{m\ n\ sin \frac{\pi}{m} sin\ \frac{\pi}{n}} cos(\phi + \theta_m - \theta_n) \right] \quad 11$$

Now there are three cases that may be investigated:

(1) A lag θ_n of the current behind the back e. m. f. of the n-phase input, with also a lag θ_m of the current behind the e. m. f. of the m-phase output.

For simplicity we will assume that $\theta_n = \theta_m$. Equation (11) then becomes same as equation (4) except that the right hand member of (4) is multiplied by $sec^2\ \theta_n$. If we take a lag of 30° $sec^2\ \theta_n = 1.33$ Hence all the results tabulated above are increased 33 per cent., and it is immaterial whether the n-phase current is the input or output, e. g., the heat loss is the same in a two-phase-three-phase conversion as in a three-phase-two-phase conversion.

(2) A lag of θ_m in the output while the incoming n-phase current is in phase with the back e. m. f.

The percentage of increase in this case will obviously depend on the kind of transformation. We have therefore to examine each of the cases of transformation considered in this paper, assuming that $\theta_m = 30°$. The values for the average heating can be readily obtained from equations (6), (8) and (10) by changing the first two constants of each according to equation (11) and substituting $cos\ (a + 30)$ and $sin\ (a + 30)$ for $cos\ a$ and $sin\ a$ respectively. This is seen to be true by referring to Fig. 1 and observing that Ø for each portion of the winding is simply increased by θ_m These substitutions will give results for single-phase to three-phase, single-phase to two-phase and two-phase to three-phase, which are given in Table II.

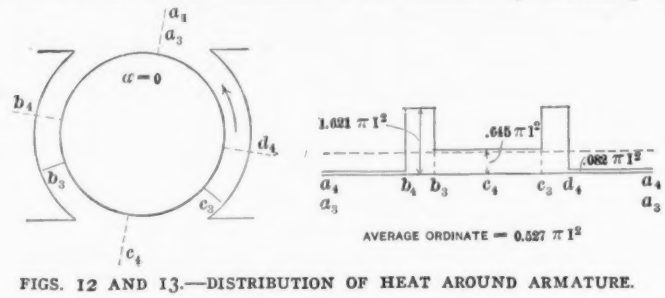
(3) A lag of θ_n in the output while the incoming m-phase current has no lag.

Although the heat loss for unity power factor is the same when transforming n-phase to m-phase as when converting m-phase to n-phase, equation (11) shows that this is not true when the same lag of 30° is placed on the output current in each case. The results are obtained by changing the first two constants of equations (6), (8) and (10) by aid of (11) and substituting for $cos\ a$ and $sin\ a$ the values $cos\ (a - 30)$ and $sin\ (a - 30)$ respectively. This gives the heating for the conversions three-phase to single-phase, two-phase to single-phase and three-phase to two-phase, and the results are embodied in Table II.

TABLE II.—HEAT LOSSES.

	Single to 3-Phase.	3-Phase to Single.	Single to 2-Phase.	2-Phase to Single.	2-Phase to 3-Phase.	3-Phase to 2-Phase.
Heat loss when lag of output current is 30°, and lag of input current = 0.	$a = 30$	$a = 30$	$a = 45$	$a = 45$	$a = 15$	$a = 15$
	2.041	2.311	1.919	2.252	0 978	0.916
	$a = 0$	$a = 0$	$a = 0$	$a = 0$	$a = 0$	$a = 0$
	1.803	2.074	1.333	1.666	0.922	0.860
Heat loss when lag of 30° exists in both input and output currents	$a = 30$	$a = 30$	$a = 45$	$a = 45$	$a = 15$	$a = 15$
	2.193	2.193	2.115	2.115	0.779	0.779
	$a = 0$	$a = 0$	$a = 0$	$a = 0$	$a = 0$	$a = 0$
	1.877	1.887	1.333	1.333	0.703	0.703

The two lower lines of numbers are obtained by increasing the



FIGS. 12 AND 13.—DISTRIBUTION OF HEAT AROUND ARMATURE.

numbers in the two upper lines of Table I. by 33 per cent. It is to be observed from an examination of these tables that, for the least heating, whether or not there is a current lag, one of the m-phase leads should coincide with one of the n-phase leads (i. e., a must equal zero). It is further seen that the percentage of increase in the heating due to a 30° lag on the output current is greater in the three-phase-two-phase conversion and *vice versa* than in the single-phase-three-phase conversion, it being 63 per cent. in the former and 28 per cent. in the latter case. It is also true that with the given lag of 30° in the output current, the heat loss is greater in converting from the greater number of phases to a less number, than the reverse, (it is to be remembered that the so-called two-phase is really four-phase), while it is the same in both cases when there is no lag.

ARMATURE REACTIONS.

In converting to or from a single-phase current there will be a periodic fluctuation of the magnetic field, and if there is a lag in the single-phased current there will be a periodic strengthening or weakening of the field, depending on whether the single-phase current is input or output. The armature reaction will be the resultant of the generator reaction and the motor reaction, and as they are opposite in effect, and since the reaction of the polyphase current is very nearly steady, while that due to the single-phase is fluctuating and opposite to the former, the resultant will obviously be fluctuating. However, in converting from one polyphase current to another polyphase current the resultant reaction will be very small unless there is a lag or lead in one of the phases greater than that in the other. With unity power factor in the input and a lag in the output current, the resultant reaction will obviously be demagnetizing, while if the reverse is the case the resultant will cause increase in field magnetism.

Like a synchronous motor, the power factor of the input can be controlled by changing the field excitation, increasing the field excitation causing leading currents, and decreasing it producing lagging currents in the input.

The e. m. f. between consecutive leads of the output bear a fixed ratio in any kind of transformation, to that between the leads of the input. This ratio is easily determined from the expression given above. $E_n = 2\ sin\ \frac{\pi}{n} E_o$. In the case of converting from single-phase

to three phase, $E_2 = .2\ E_0$, $E_3 = \sqrt{3}\ E_0$, hence $E_3 = \frac{1}{2}\sqrt{3}\ E_2$, i. e., 100 volts impressed on the single-phase side will give 86 volts on the three-phase side, assuming a sine distribution of magnetism. And since, in the so-called two-phase system, opposite leads form one of the phases, and since the e. m. f. of this system is that between these two leads, the ratio of pressures in converting two-phase to three-phase is same as that for single-phase-three-phase conversion. For the same reason, it is obvious that in the single-phase-two-phase conversion the ratio of e. m. fs. is unity.

Compounding of Alternating-Current Generators.

In the report in these columns of the recent meeting at Cleveland of the Ohio State Electric Light Association, an abstract was included of a paper read by Mr. H. G. Reist on the new method of compounding employed by the General Electric Company, and in a more recent issue an article appeared giving further details. To supplement this information an abstract is given below of the specifications of the patent of Mr. E. W. Rice, Jr., on this method of compounding, which includes a fuller technical account than was contained in either of the above mentioned articles.

The method of compounding referred to consists in passing the current of the generator to be regulated through the armature of the exciter, thereby producing in the exciter armature alternating polarities which reverse in synchronism with the movements of the armature in space across its field poles.

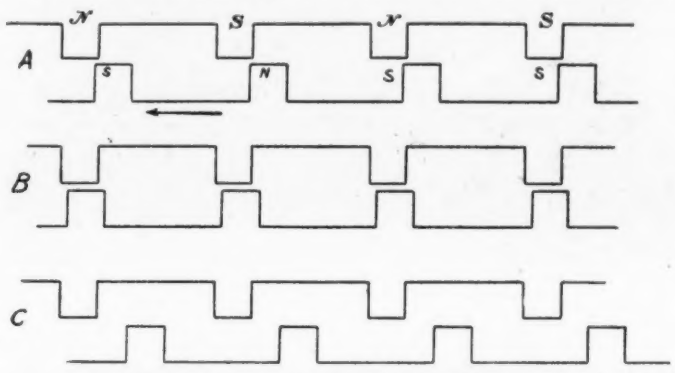
A continuous current exciter of the ordinary kind furnishes current for exciting the field magnets of the generator. The exciter comprises an armature with a direct current winding and commutator of the ordinary type. Should the machine run at the same speed as the generator—for example, when its armature is on the generator shaft—the field magnet has the same number of poles as the generator. The current induced in the armature of the exciter is rectified by a commutator in the usual way, and excites its own field magnet and also the field magnets of the main machine, as has heretofore been customary. The current in the main generator is also passed through the armature of the exciter (a series transformer being generally employed, though not necessarily), and in so doing develops alternating polarities therein which react upon the field magnetization of the exciter and so varies its voltage. The amount of this reaction and the consequent regulation secured will correspond to the strength of the main current passed through the armature, and also with the phase relation of the current.

The connections between the armatures of the two machines are so made that the polarities induced in the exciting armature are of opposite sign to the adjacent field poles at any given instant, and somewhat ahead of the exciter field magnetization. The result is that with increase of main current the current passing through the exciter armature strengthens to a correspondingly greater degree the exciter field, and thereby the excitation of the main alternator. If there is an inductive load and the current lags, the magnetization induced by the alternating current passed through the exciter armature comes more nearly in line with the exciter field magnetization, thus strengthening it more and increasing the excitation of the alternator. On the contrary, should the current lead, the magnetization of the exciter armature due to this current is less in line with that of the exciter field and thereby strengthens it less and may even be in opposition to the exciter field and so weaken it. In some cases the arrangement may be such that the polarities induced in the armature of the machine regulated by armature reaction will be of like sign to the adjacent field poles, so that regulation is due to differential rather than the cumulative action of the magnet fields, the armature poles in this case weakening instead of strengthening the field poles.

The latter method is especially desirable in constant-current machines or systems, while the first mentioned arrangement is better adapted to constant potential machines.

By means of this arrangement, the phase relation of current and e. m. f. is corrected by regulating the generator. For example, if the current in the circuit of an alternator lags behind the impressed e. m. f. at the terminals of the machine, the potential will become less than it would under the same conditions were the current in phase with the e. m. f. On the contrary, if the current becomes leading, the potential would tend to rise. A distinctive feature of the Rice arrangement is that the generaor in such cases may be automatically regulated to correspond with the various phase relations existing in the circuit under different conditions, so that should the current fall out of phase and become lagging, such a change of itself brings about directly or indirectly, the necessary regulation of the generator to suit the condition assumed. The same holds true if the current becomes leading instead of lagging.

Referring to the accompanying figure, the upper parts of the several portions represent the field poles of the exciter, which are alternately of north and south polarity, as indicated. The several lower portions represent poles induced by the main alternating current in the exciter armature which, it is assumed, is to rotate across the field poles to the left as indicated by the arrow. The alternating currents are tapped into the armature, preferably so that the polarities induced in the poles are of opposite sign to the adjacent field poles, as represented by *s n*; and the adjustments are such that these polarities become a maximum just before the armature poles stand opposite to the adjacent fields. With this arrangement it is evident that the field poles will be strengthened by the polarities induced in the adjacent poles, and that this strengthening effect will become more or less great with variations in the strength of the armature current, strengthening or weakening the armature polarities, thus giving a compound effect to the exciter and indirectly to the main alternator corresponding with the current generated in the latter. If, now, the current lags, the polarities induced in the armature will reach a maximum an instant later than when the currents are in phase. Hence, at the time the armature polarities reach a maximum, the field poles will be more nearly in line with the armature poles, thereby strengthening the field poles to a greater degree and raising the potential of both exciter and main machines. If, on the other hand, the current leads, the armature polarities will reach a maximum when the armature poles are less in line with the corresponding field poles and the strengthening effect



RELATIVE POSITIONS OF FIELD AND ARMATURE POLES.

upon the field poles will be less than in the former case. In this way the potential of the exciter is automatically lowered and the potential of the main machine lowered correspondingly.

As will be seen from the above, by the reactive influence upon the field of the exciter produced by the current from the generator fed through the exciter armature, the resultant field magnetism of the exciter, and consequently its voltage, is varied automatically from time to time, so that the current derived from its commutator and used for exciting the field of the main machine, preserves the field magnetization of the main machine at such a value as to render it self-regulating under varying conditions of load.

In some instances the result to be secured will make it advisable to pass through the exciter armature not the main current of the machine, but a current proportional to its voltage. That is, in one case the main current or a shunted portion of the main current may be fed to the armature of the exciter; in the other case the armature of the exciter will be included in the shunt circuit across the brushes of the main machine.

The Convention of the Northwestern Electrical Association.

Papers will be read at the eighth annual convention of the Northwestern Association, which will be held in Milwaukee Jan. 17, 1900, by Prof. Jackson, Prof. Shepardson, Prof. Richter, R. Fleming, W. H. Schott, H. W. Frund, N. H. Dow and G. Van Ness, all on subjects of practical interest to central station men. The meeting will be held at the Hotel Pfister. An interesting programme has been arranged for the entertainment of the members and friends. The usual reduced railway fares have been arranged for.

Lighting and Power Installation of the New Post Office Department Building, Washington, D. C.

By J. P. Alexander.

The recent occupation by the Post Office Department and the Washington City Post Office of the new building on the south side

FIG. 1.—NEW POST OFFICE DEPARTMENT BUILDING.

of Pennsylvania Avenue, corner of Eleventh Street, has called into service heating, hydraulic and electric elevator and lighting installations as extensive, perhaps, as can be found in any public or private building in the country.

The steam plant consists of twelve horizontal tubular boilers of 125-hp each which are set facing in two rows upon the east and west sides of a boiler room 60 x 100 feet. This is located under the centre of the building and directly south of the engine room, which is of the same dimensions. The arrangement is in batteries of three boilers each, four flues starting from the boiler room.

In the centre of the area between the boilers two 14-inch overhead steam mains, with Chapman valves connecting them, take steam through 6-inch pipes leading out from each boiler, half and quarter bends of the latter allowing expansion and thorough drainage, while the system of valves allows any boiler or set of boilers to contribute to the steam supply. The feed water is partially derived from the condensation of the exhaust steam heating system. Two feed pumps operate automatically to furnish feed water as needed. The two rows of boilers are equipped with Roney stokers, with two 10-hp Westinghouse engines attached. The average steam pressure noted was 95 lbs.

From the boiler room a 12-inch main carries steam to each of two separators, one in the northeast corner of the boiler room next to the engine room, the other being located about the centre of the electrical portion of the engine room, the west half being taken up with hydraulic elevator pumps, steam heating system, air pumps, tanks and auxiliary machinery.

There are four units in the electrical installation, which consists of four 120-kw Thresher direct-coupled dynamos running at 240 revolutions, and delivering current at 115 volts. These machines have been observed to stand a drop of 650 amperes without sparking. The units are arranged in two sets parallel with the east side of the engine room, with cylinders end to end, right and left-handed units being paired.

The four engines are of the Buckeye tandem compound type. They indicate 250-hp each, and take steam from the central separator, the exhaust going into the steam-heating system of the building.

From the dynamos lead-sheathed cables deliver the current at the switchboard through terra cotta floor conduits. The cables are stranded and of 750,000 and 1,000,000 circular mils in cross-section, the ends of the cables being at the three-pole switches at the base of the switchboard. These four switches, equalizer and busbars make a number of combinations possible, while the down-throw of a large 3000-ampere triple-pole double-throw switch will give immediate connection, should necessity require, with the mains of the United States Electric Lighting Company.

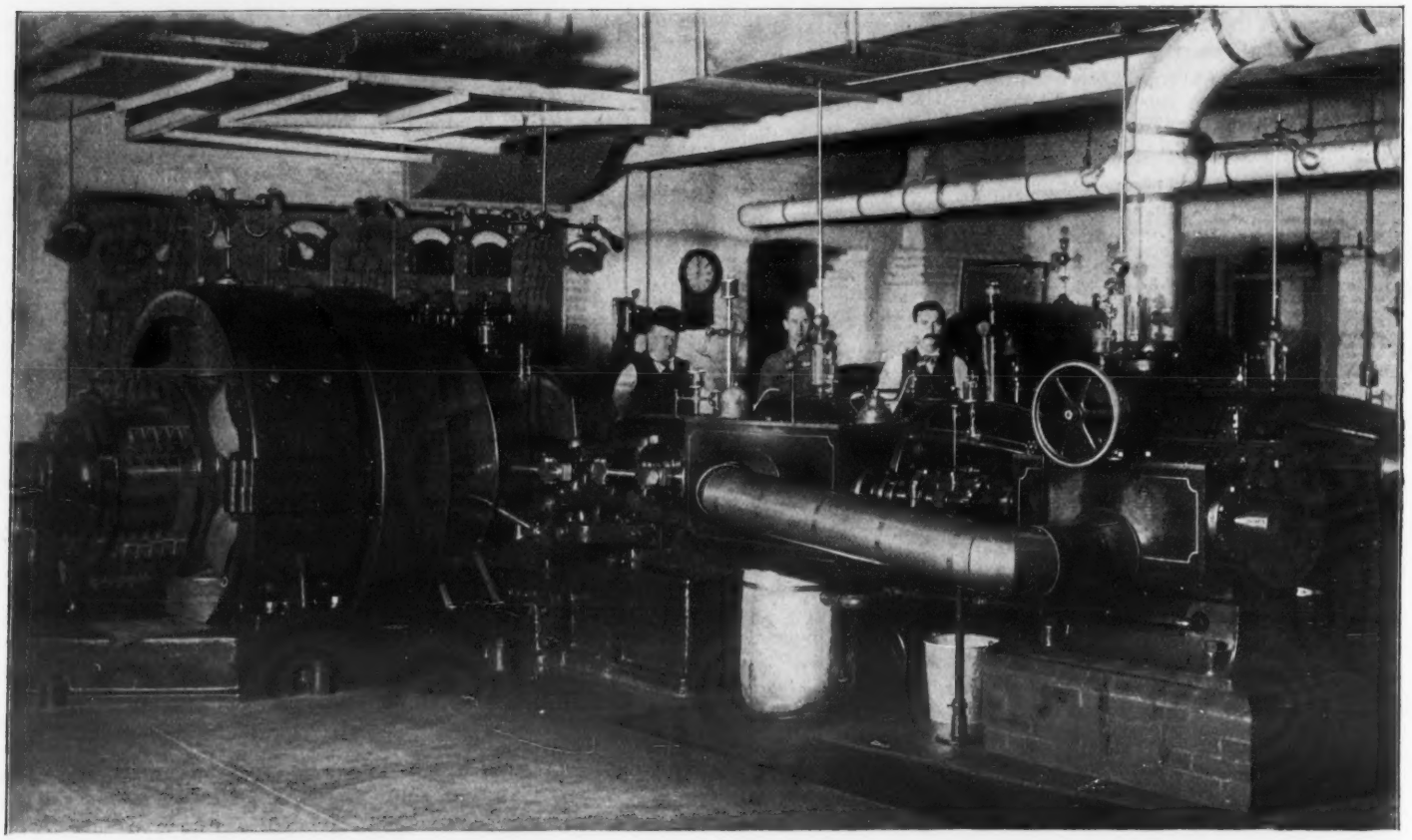


FIG. 2.—ENGINE AND DYNAMO ROOM, NEW POST OFFICE BUILDING, WASHINGTON.

Below the individual machine switches are four Thomson recording wattmeters. Four Weston illuminated dial ammeters and two hinge-swung illuminated dial voltmeters indicate the amperage and voltage. The circuit breakers are of the LaRoche type, and are four in number. They are located about the centre of the switchboard, the end panels being given over to motor and light circuits. Ward Leonard rheostat handles stand out under each of the circuit breakers, the nickeled hand-wheels adding materially to the looks of the gray marble panels.

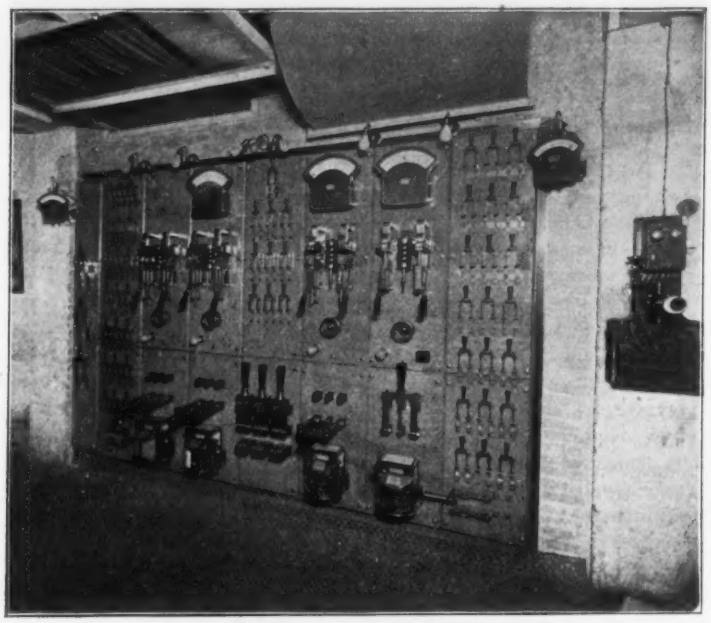


FIG. 3.—SWITCHBOARD.

There are forty-two lighting and four power circuits. Four of the former go to the four corners respectively of each of the nine floors, the cables for the same being led along the engine room ceiling to a light shaft through which they rise to their respective floors. Two of those denominated power circuits furnish light as well to the general post office floor. On one of these, twelve cancelling machines are operated by one horse-power Crocker-Wheeler motors. The other two power circuits and two electric elevators circuits are encased in steel conduits, the first pair operating two 26-hp Thresher motors equipped with separate white marble switchboards mounted with rheostats, circuit-breakers and ammeters. The motors are flexibly connected, each to a six-foot ventilating fan, deriving air supply through cheesecloth screens set across the fresh air windows. Tempering coils are provided in case the air derived is too moist or cold.

There are two electric lifts and a private elevator for the use of the Postmaster General. The lifts are used for raising finished accounts to the files from the eighth to the ninth floor. The elevator motors are about 15-hp, and were made by the Western Electric Company. The Postmaster General's elevators runs from the second to the eighth floor. The car is finished in artistic metal work, has a special safety brake, and is quite noiseless. The operating motor and drums are set directly over the shaft on the ninth floor.

Hill & Miller, of Washington, are now supplying two motors of their own design and make for running extra ventilating fans for the boiler and engine rooms. These, with four Crocker-Wheeler direct-coupled one horse-power motors on the printing presses of the stationery office, complete the power equipment of the building.

All the lighting circuits on each floor are controlled from marble tablet boards with glass faces located at convenient points in the halls. The wiring is in steel conduits, of which there are over 102,000 feet altogether. The hall circuits are operated from knife switches in the tablet boxes, while the office and room circuits have flush push-button switches.

The fixtures, which were furnished by Cassidy & Co., of New York, are the handsomest that have been furnished any of the government buildings. They grade from the simpler wall lights on the top floors to the most expensive office fixtures and chandeliers on the lower ones. In the public hall on the first floor there are 101 three-light opalescent bull's-eyes set in the hardwood main screen that separates the hall from the main working floor. The ten massive chandeliers are finished in bronze like the other fixtures of the building, and are extremely ornamental. Those on the Pennsylvania Avenue side are particularly so, being of an octagonal pyramidal form with opalescent glass curtains hooding the light.

Within the general post office the lighting most favored and practiced is from clusters of three and five lights, the switches for these and the cancelling machine circuits being placed on marble switchboards set back to back.

One hundred and twenty telephones, all of the long-distance type, are connected with the building "central," which in turn can connect with any telephone in Washington or Baltimore. These, with the many annunciator and call-bell circuits, practically complete the electrical equipment of the building.

All telephones observed were manufactured by the Western Electric Company, of Chicago, and the lamps of the Columbia Lamp Co., of St. Louis, were, on the strength of a recent test, bought in considerable quantity.

Mr. J. H. Lloyd, chief electrician of the Post Office Department, mentioned that as soon as the present repair shop is fully equipped, he will place arc lights in the clock tower and devise convenient power circuits for the automobile collection and mail wagons that are being seriously considered by the authorities.

The steam engineering features of the plant, as well as those of the hydraulic, ventilating and heating systems, are under the direction of Mr. J. O'Donnell, chief engineer, who kindly supplied much of the information included herein.

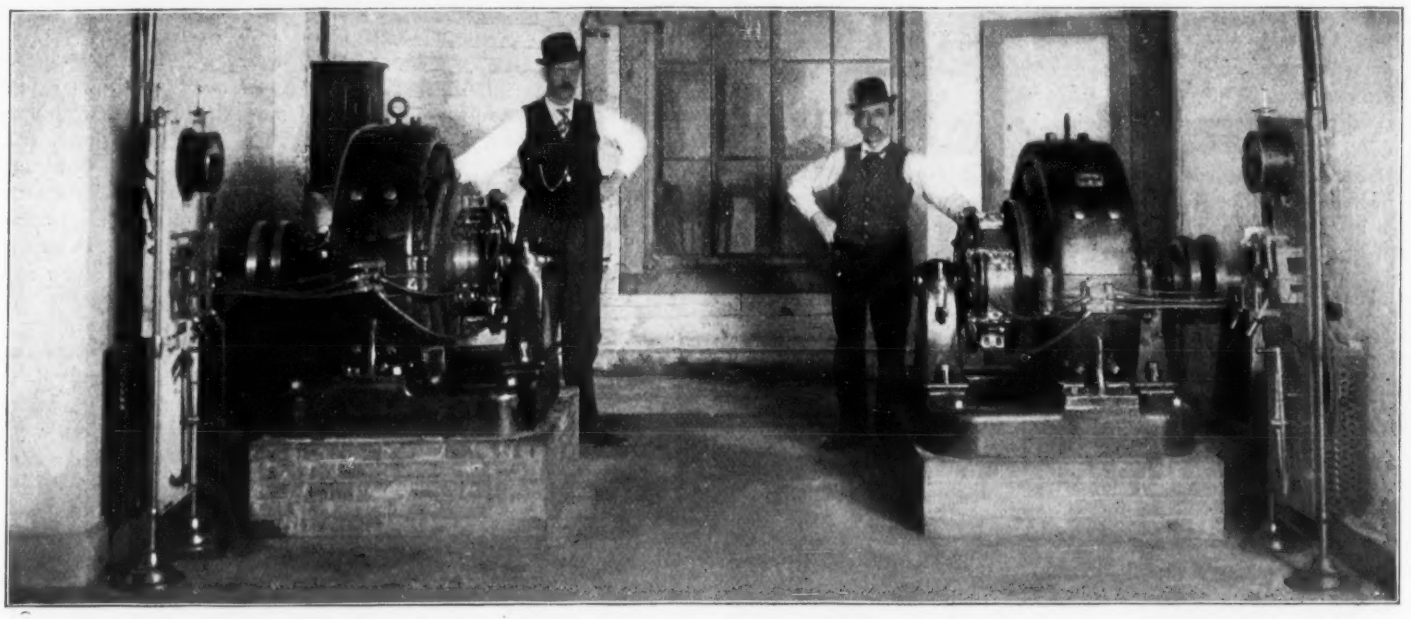


FIG. 4.—VENTILATING FAN MOTORS.

Electricity Supply from Central Stations.

A well attended and most interesting meeting of the New York Electrical Society was held at the College of the City of New York on December 21, when Mr. John W. Lieb, Jr., E. E., assistant general manager of the New York Gas and Electric Light, Heat and Power Co., delivered an address, entitled: "Electricity Supply From Central Stations, Covering Recent Developments in the Construction and Operation of Central Stations in Our Great Cities." It occupied nearly two hours in delivery, and every word was listened to with rapt attention. President Dunn was in the chair.

The speaker opened his remarks by a reference to the extent and character of the territory included within the limits of Manhattan Island, pointing out that this field presents nearly all of the varying conditions of electricity supply, covering many of the problems connected with the generation and distribution of electricity for lighting and power purposes.

After a brief review of the history of the electric lighting industry previous to the starting of the old Pearl Street station of the Edison Company, an interesting picture was presented of that pioneer lighting plant, including piquant personal reminiscences of the early difficulties encountered in the construction and operation of the station machinery and how they were successfully overcome. Some interesting maps were shown, including maps of the original underground system, diagrams illustrating a house-to-house canvass made by Mr. Edison, showing all the gas light and power users in the district, and a map on which future distributing stations or substations are laid out, covering all the territory up to Central Park, within which thirty-eight distributing centers were located.

Series of curves were presented, showing the development of the business of the New York Edison Company from 1883 to date, including curves of income, load, connected installations, etc., etc. The loads carried by the several stations connected to the system were shown by vari-colored curves, and explanations were given of the character of the business in each district as reflected in the peculiarities in the forms of the curves. Parallel curves, exhibiting the variations from month to month and from year to year, formed a graphic indication of the effect of the season and the variations in the hours of the rising and setting of the sun.

A sectional plan was shown of the water-side station now being constructed between Thirty-eighth and Thirty-ninth Streets and the East River, by the New York Gas and Electric Light, Heat and Power Company.

The equipment of this station (preliminary plans of which were illustrated and described in these pages early in 1899), covering a plot 190 feet by 273 feet, was described in detail, and data was given of the efficiency which it is expected to obtain from the engines, generators, etc. The complete plant will consist of sixteen three-crank compound condensing engines, 75 rev. per minute, and developing each 5200 indicated hp at most economical cut-off, and nearly 10,000-hp at maximum power. Each engine will be direct connected to a three-phase generator operating at 6600 volts and rated at 3500 kilowatts, but capable of operating with a load of 4500 kilowatts for three hours. Fifty-six boilers, each of 6400 square feet of heating surface, will furnish the steam supply, and it is proposed to equip the boilers with super-heaters in addition to the usual complement of automatic stokers, feed water heaters, feed pumps, etc. The products of combustion will be discharged into four steel stacks, each 19 feet in diameter and 196 feet high above the grates, supplemented, when necessary, by forced draught from fan blowers.

A map of the extensive underground system supplied with current from the Edison Company and by the companies associated with it, under the administration of the New York Gas and Electric Light, Heat and Power Company, was shown, for which the water-side station is to furnish the main current supply. A number of rotary converter stations now in course of construction at Horatio Street, West Eighty-fourth Street, East One Hundred and Twenty-first Street and West One Hundred and Twenty-fourth Street, will be equipped with rotary converters and storage batteries, permitting of an extension of the direct current underground system into new and hitherto unoccupied territory, and, together with rotary converter equipments at several of the present generating stations, will afford at once a considerable outlet for the high tension three-phase current generated at the water-side station, enabling also some of the less economical generating apparatus to be put out of commission and to be used during only a few months of the year on the peak of the load. The speaker then briefly touched on many details in the method of distribution in future of series arc lighting, rectifiers, etc., etc., which the lateness of the hour made it impossible to discuss at length.

A vote of thanks to Mr. Lieb, who is a past president of the Society, was carried enthusiastically on the motion of Messrs. Coho and Mailloux, the point being brought out in their remarks that Mr. Lieb had also been one of the first to develop central station engineering in Europe, through his management of the old Edison Milan station, which has been most successful and which to-day continues to be one of the most prosperous and progressive in Europe.

Annealing Armor Plates.

At the meeting of the Engineers' Club, of Philadelphia, Dec. 16, Mr. C. J. Dougherty, the superintendent of the electrical department of the Cramp shipyard. read an interesting paper on "The Electrical Process of Annealing Armor Plates in the Construction of Warships," which was illustrated with slides showing the way in which battleships are armored and the construction and application of the apparatus for annealing the plates. The armor plates are known as Harveyized plates, and are hardened on their surface to a depth of about seven-eighths of an inch, the hardness being so great that they cannot be drilled. In order to properly mount them, they must first be locally annealed in the spots where they are to be drilled, and after futile efforts to do this by other means, the electrical method was resorted to, and has proved to be so successful that it is now used entirely by those builders. In principle the apparatus is like the well-known Thomson electric welder, the ends of the secondary coils being held on the surface of the plate at the spot which is to be annealed; the secondary current therefore passes through the surface of that portion of the iron and raises it to a red heat, which draws the temper of the hardened shell. As the chilling action produced by the surrounding iron is great enough to restore the temper if the current is stopped suddenly, the current is reduced very gradually, from 10 to 20 minutes being allowed for this gradual diminution. The apparatus consists of a transformer, the secondary of which is made of a very large copper casting closely surrounding the primary, and both are surrounded by iron; the secondary is slit in one spot, and the two ends terminate in the contact points. The transformer is surrounded with oil, and the terminals are kept cool by a flow of water through them. The ratio of transformation is 100 to 1, the primary current about 100 amperes at 300 volts, and the secondary about 10,000 amperes at 2.5 to 2.8 volts. The contact surfaces are only about half a square inch, and the current density at those spots is therefore about 40,000 amperes per square inch. The total weight of the transformer is about 1,000 pounds, which, when resting on the plate, is sufficient to make good contact. Directly under these contacts the metal remains hard and cannot be drilled; the space to be drilled lies midway between the two contacts. The alternator, of which there is one for each transformer, is separately excited, and is driven by a continuous current motor, which is connected to the continuous current power mains running throughout the yard. These two machines together are transported to where the work is to be done. The annealing current is regulated by regulating the exciting current of the alternator, the rheostat for which is placed where the work is to be done; four wires are therefore required from the work to the generator. Two of these sets of annealers have been in use by the Cramps for some time. The plates for the Alabama were all annealed in this way. The Harveyized plates are now being superseded by the Krupp plates, which are hardened to a depth of two inches instead of only seven-eighths inch, but notwithstanding this greater depth, the electric method of annealing is found to answer very well for these also. The fact that the generating machinery, together with the whole shed which protects it, was transported about the yards to near the work, instead of running mains from a stationary plant, was explained by the statement that it was less trouble to transport this machinery than to run the wires. With the present system each transformer must have its own alternator and exciter, and in this connection the question arose in the discussion, why choking coils are not used in the secondary circuit instead, which would require the running of but two wires, and would enable both transformers to be supplied from the same alternator. The reason why this apparently simpler method is not used was not explained.

Electric Lighting Plant and Street Lamps of Trieste, Austria.

BY JOSEF HERZOG.

AT Trieste, the important Austrian seaport of the Adriatic, a large electric lighting plant has just been completed. Only a few years ago incoming ships had to discharge their cargoes on the steep and rocky shores of the harbor. Now there are splendid moles, lighted by a great number of tastefully designed and mounted arc lamps, which spread a dazzling light and enable seamen to see from a great distance where they can find a safe and suitable berth for discharging their cargo.

The authorities of the City of Trieste invited public tenders for the construction of the plant, and to the firm of Ganz & Co., of Buda Pest, was intrusted the execution of the work. The central station is located about two miles distant from the centre of the town and near the gas works, so that the management of both establishments may be conducted under one head.

The engine house has been designed for five sets of machines, of which three sets have been installed. The three-phase generators—which have a stationary armature and rotating field magnets—are direct-coupled to suitable steam engines, and at 105 revolutions per minute generate a voltage of 2000. The exciter armature is mounted directly on the shaft of the generator.

The horizontal tandem steam engines used were built by the firm of F. Tosi, of Legnano. The pumps for the surface-condenser are placed beneath, and driven by the engines. The necessary cooling water is pumped from the sea through a pipe-line about 1300 feet long.

The boiler plant is composed to-day of five Tischbein boilers, each working at a pressure of 11 atmospheres. They were furnished by the firm of F. Ringhoffer, of Prague-Smichow. The switchboard is noticeable for its simplicity, as only the several shunt rheostats for the exciters and the absolutely necessary measuring and switching apparatus are mounted on it.

FIG. 1.—ARC LAMPS ON QUAY, TRIESTE.

From the switchboard, two three-conductor underground cables conduct the current to the town, where it is distributed to various substations. Most of these substations are in the form of small, handsome iron houses, as shown in one of the cuts, the exteriors of which are used as advertising kiosks. In the upper part of these small houses are placed the transformers, which step down the high-tension current from 2000 volts to a voltage of 105.

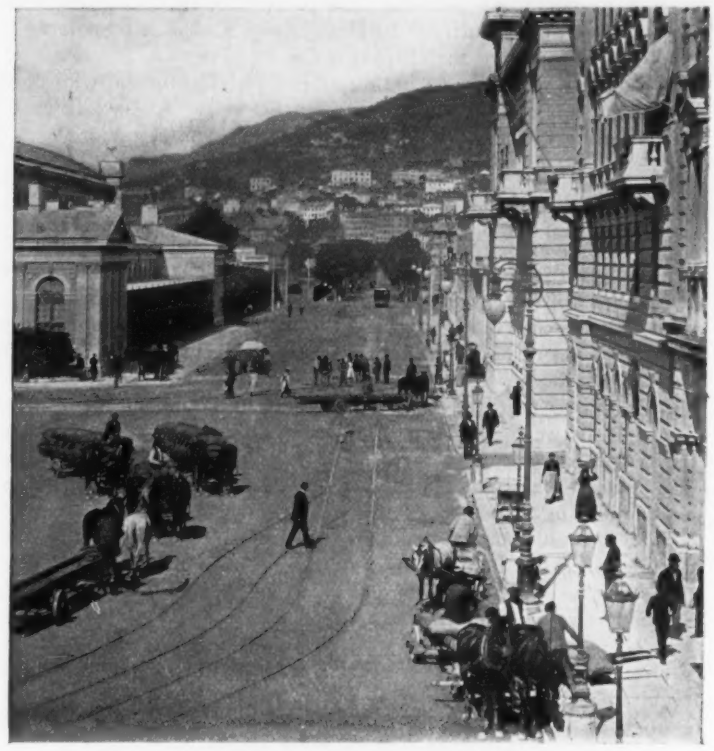


FIG. 2.—STREET ARC LAMPS.

FIG. 3.—KIOSK TRANSFORMER SUBSTATION.

The street lighting is effected by 100 arc lamps, which are oper-

ated entirely independently of each other. Each is fed by a small transformer, which is placed in the base of each lamp pole and reduces the pressure to 35 volts. The accompanying illustration of a view on one of the Adriatic landings shows such a lamp-pole as is supplied by the firm of Siri, Lizard & Co., of Milan.

Professor Kapp, of the Charlottenberg Polytechnicum, who conducted the test of this plant, expressed his entire satisfaction as to the execution of the work as well as to the system selected.

Incandescent Lamps.

At the November meeting of the Franklin Institute, Lieut. F. W. Willcox read a paper entitled "Incandescent Lamps," in which every phase of the subject is treated at length, the paper forming in fact perhaps the most extensive contribution from the modern standpoint yet made to the subject. From this paper the following abstract has been prepared.

It is stated that the total production of lamps in the United States is between 15,000,000 and 20,000,000 per year, and adding the output of European factories, brings the figure to 25,000,000. Assuming the cost of a lamp at 20 cents, this represents an annual expenditure of $5,000,000 for this one accessory of electric lighting.

With the old bamboo filament, the Edison factory for the production of 20,000 lamps employed 350 people cutting fibre. With twice this production of lamps, or 40,000 per day, but 25 people are necessary to produce the squirted filament. With the bamboo over 90 per cent. of the crude material was wasted, while with the squirted filament over 95 per cent. is utilized. The bamboo filament required treatment in order to fill in uneven parts with a carbon deposit in order to render the cross-section of the filament uniform. The squirted filaments are also subjected to treatment, but for the purpose of depositing a dense surface coating of graphitic carbon which is more durable than the filament base of amorphous carbon and also serves to increase the emissivity of the filament. The earlier methods of treatment required that a filament be

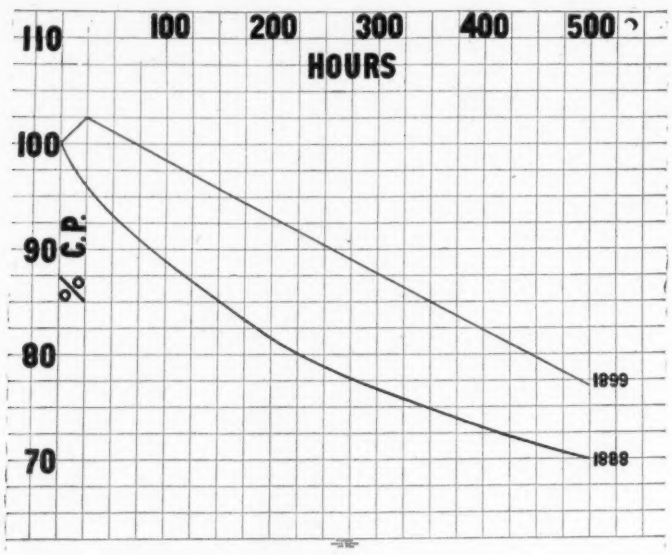


FIG. 1.—COMPARISON OF EARLY AND MODERN 3.1-WATT LAMPS.

treated by steps; that is, treated a few seconds, then taken out, measured, and so on until the desired resistance was obtained. At present an automatic Wheatstone arrangement is used which instantly arrests the treatment when the desired resistance is reached, and which has resulted in reducing the number of employees one-quarter of that formerly necessary.

Formerly it required five hours to exhaust a lamp, which time has been reduced to one minute by the employment of the chemical process. It is stated that this process more than any other one thing has assisted in the production of a succesful 220-volt lamp.

Of any lot of lamps under manufacture not more than one-quarter will come out at the voltage aimed for. This means, for example, that to produce 10,000 lamps for any given voltage, it is necessary to make between 30,000 and 40,000 and then cull from these the 10,000 lamps desired. It is recommended that a number of stations shall agree to operate at different voltages and thus secure the benefit to be derived from purchasing lamps of odd voltages.

Over 400,000 200-250-volt lamps are now being annually supplied consumers, and their use is rapidly extending. The economy of this type of lamp is 4 watts per candle or lower, at which they give a useful life about one-third longer than the 3.1-watt 110-volt lamp. A 3½-watt 200-250-volt lamp is practicable, but their more general adoption is checked by two circumstances—first, the lack of close regulation in the average high-voltage station, and second, the general practice of such stations of compelling the customers to buy and supply the lamps used.

There are more than three times as many 110-volt lamps used to-day as are made. This means that the average customer who orders 110-volt lamps gets lamps marked 110, but really of some other voltage—as low as 107 or as high as 113.

In referring to the improvements in lamps, it is stated that while it is true that the so-called 3.1-watt lamp has been in the market for some years, while the early lamp of this economy only consumed 3.1 watts per candle of light at the start, it rapidly deteriorated, having an average economy of 3.8 watts per candle. On the other hand, the lamp of to-day drops very little in economy during its life.

Comparing 16 and 8-cp lamps, it is stated that the latter are inferior for the reason that the lamp of lower candle-power has a thinner and more delicate filament which cannot be made to give the same economy in either life or maintained candle-power as the 16-cp lamp.

The proportion of different lamp bases in use to-day is given as follows: Edison, 55 per cent.; Thomson-Houston, 25 per cent.; Westinghouse, 15 per cent.; all others, 5 per cent.

Fig. 1 illustrates the difference between the early 3.1-watt lamp and the same lamp as made to-day. The lower curve shows the candle-power performance by hours of burning for the former, and the upper one for the latter. The early lamp reaches 80 per cent. of 16-cp at 200 hours and the present lamp at the same candle-power 450 hours.

Lamps are now purchased by all large users on what is known as the future delivery system. The customer places an order for

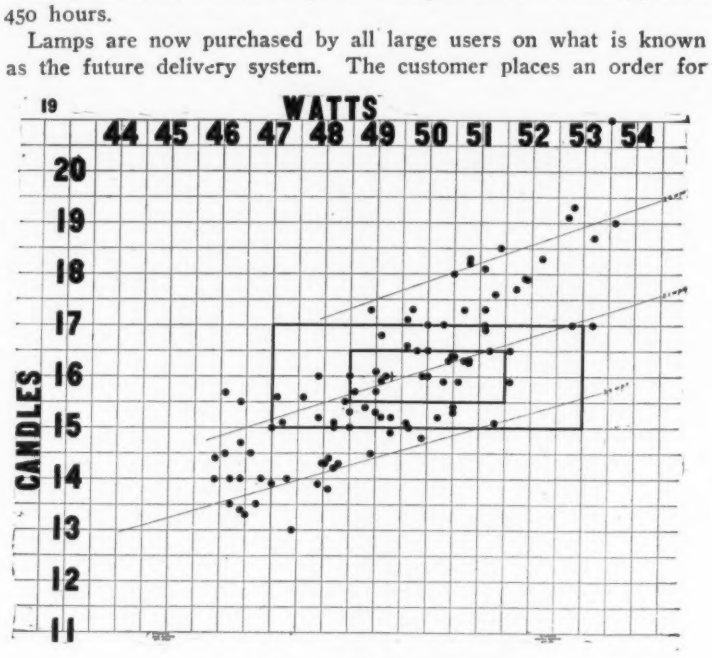


FIG. 2.—TARGET DIAGRAMS, POOR LAMPS.

his year's needs and the lamps are shipped during the year as required. This system permits the manufacturer to run his factory throughout the year, thereby avoiding the old conditions of a heavy rush in fall and winter and reduced output in summer. It also guides the manufacturer as to the classes and types of lamps desired and the number of each, thus enabling him to avoid producing dead stock. Until this system was adopted, over 100,000 lamps that could not be sold had to be annually broken up.

An estimate is given of the number of varieties of lamp that are required from the lamp manufacturer to-day. Of standard lamps there are nine different candle-powers, three different economies and at least six different bases, thus making 162 varieties. In voltages, there are at least fifty voltages which increase the number to 8100. These may be frosted or colored, which results in another multiplier of six, giving in all 48,600 varieties. On a similar basis of calculation applied to tubular, round bulb, stereopticon, multiple and series candelabra, special series, regular battery, special battery, navy lamps, resistance lamps, foreign lamps, reflector lamps,

night lamps and series lamps for alternating arc lighting, a total of 147,100 varieties is reached. It is not stated, however, that a lamp manufacturer keeps this number in stock.

A reason advanced as to why electric lighting in the United States is so far ahead of the service abroad is that in this country the supply of lamps has been largely taken out of the hands of the customer and the service arranged on a free renewal basis. This prevents the customer from depreciating results and balking the efforts of the central station management to give a good service, as

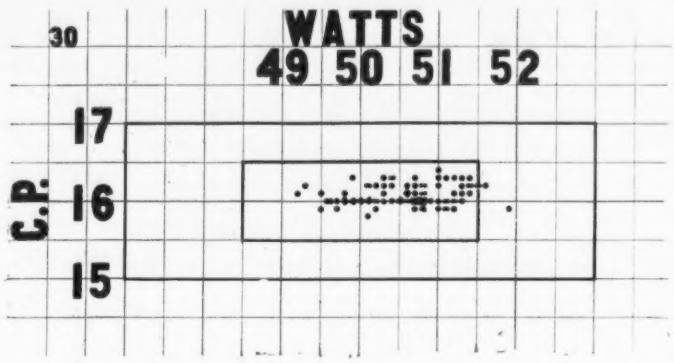


FIG. 3.—TARGET DIAGRAMS, GOOD LAMPS.

poor lighting is an inevitable result where the customer buys and renews his lamps.

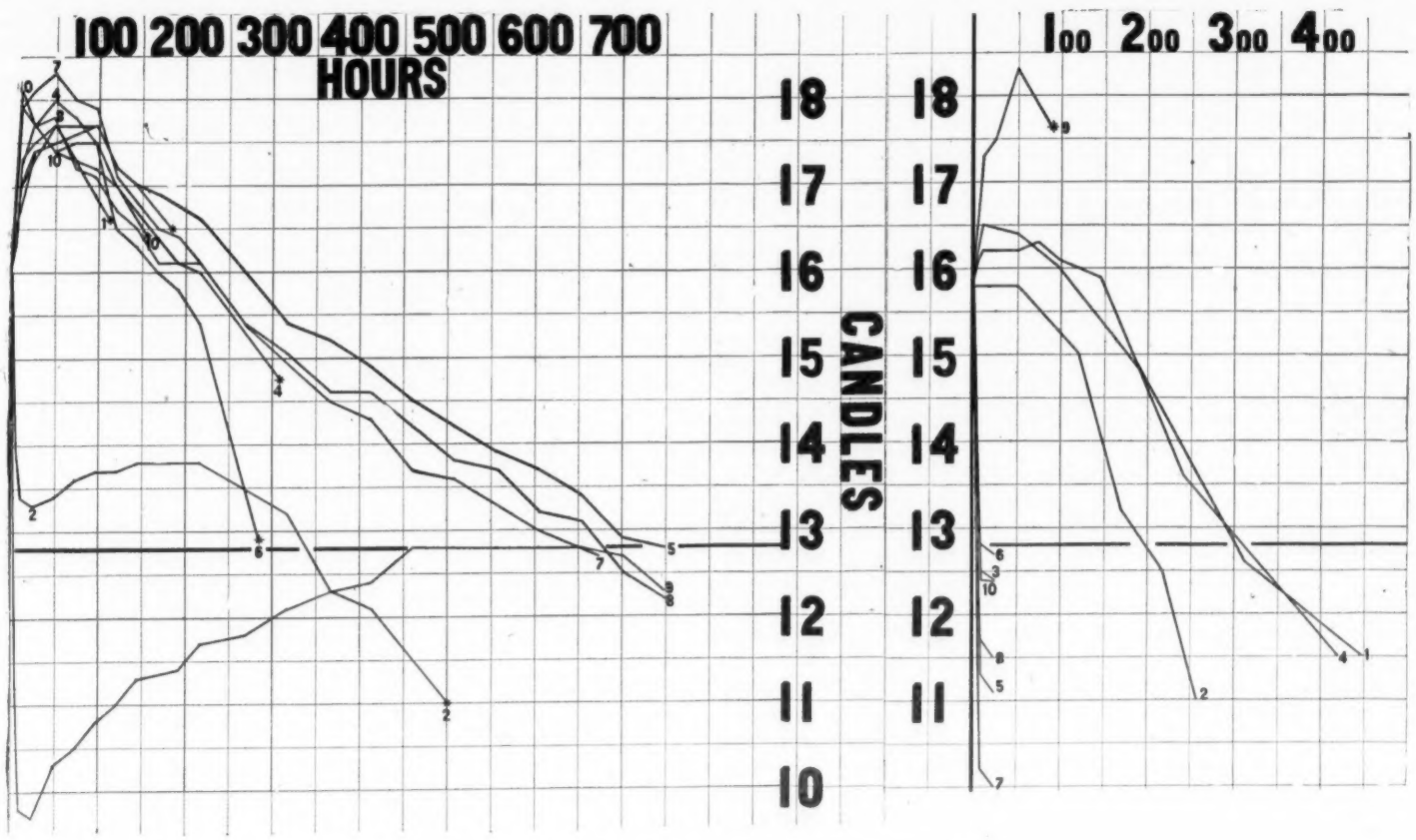
At the present low price of lamps the cost of 600 hours or 1000 hours of service is from 8 to 10 times the value of the lamp. It is therefore economical to the highest degree to use the lamp of highest economy possible and replace lamps frequently, since it is evident that the value of the current consumed by a lamp burned too long eats up the value of several lamps. The useful life of a lamp is the period up to a loss of 20 per cent. of candle-power, which period averages to-day about 400 hours for the best 3.1-watt 100-125-volt lamp.

Modern methods of tests cover three general features: A physical examination for defects in filament and mechanical parts of the lamp and for vacuum; an initial test for correctness in rating and candle-power in watts at the rated voltage, and a life and candle-power performance test.

The test for vacuum is made with an induction coil giving about a ⅜-inch spark. By touching the base of a lamp to one of the secondary terminals of such a coil, a glow or fluorescence is caused inside the lamp when it is not properly exhausted. A well-exhausted lamp will either show no glow at all or merely a slight flash or fluorescence. By burning a lamp dull red any spots on the filament are seen very distinctly. Such spots are serious faults and will quickly cause the filament to burn out. Tests for this defect can readily be made by burning the lamps two in series, when the spots will show as bright points against the dull red of the filament. Another serious fault in the filament is discoloration of filaments, such discoloration causing a rapid loss of candle-power. This can be detected by an eye examination of the filament by light with no current on. It should be an invariable rule in the purchase of lamps to reject any lot, samples from which are shown on test to contain 10 per cent. of any of the above defects.

Correct initial rating of candle-power and wattage is determined by simultaneous current, voltage and photometer readings. The results may be plotted by what is called the "target diagram" method. Referring to Fig. 2, the candle-powers are plotted as ordinates and the watts as abscissae. The centre of the diagram or bull's-eye is made the intersection of the 16-cp line and the 50-watt line. The readings taken upon each lamp of the lot tested are plotted by placing a dot at the intersection of the corresponding candle-power and watts line, and in this way the entire number tested is plotted. Fig. 2 shows the specification for good lamps. The inclined lines shown give the watts per candle. The rectangle is the locus of satisfactory lamps. Fig. 3 shows the results of tests of 100 high-grade lamps and illustrates what may be expected from well-made lamps.

In Fig. 5 are plotted the candle-powers at different number of hours. Ten lamps were set up rated at an average economy of 3½ watts per candle, and six of them lost over 20 per cent. in candle-power in ten hours, only three lamps giving an extended life. Fig. 4 illustrates the rise in candle-power at starting. Owing to this initial rise in candle-power during tests, readings should be taken every 25 hours for the first 100 hours. All lamps will rise some at the start, but this rise should be limited, as if in excess it strains the filament and causes early breakage, as is well exemplified by the curves. Fig. 5 refers to ten lamps started at 3½ watts per candle; some early rose to 18 candles with consequent early breakage. Two of the lamps slumped badly, and one of the curves shows a curious recovery, regaining 3 candles to 13 candles after having dropped to



FIGS. 4 AND 5.—CURVES OF LIFE AND CANDLE-POWER TEST.

10 candles. This is a frequent performance quite often met with in lamp testing. The explanation is that the filament had a discolored or blackened surface through poor vacuum; as the vacuum improves the discolored coating is burned off which makes the filament a better radiator of light and thus caused a subsequent rise in candle-power.

An American Pacific Cable.*

BY CAPT. GEORGE OWEN SQUIER, U. S. V., U. S. SIGNAL SERVICE.

AFTER reviewing carefully the history of the subject, Capt. Squier showed that two plans were competing for public attention, one British and one American. At this moment a Pacific cable touching only soil belonging to Great Britain is assured, both Canada and Australasia recently having been reported as joining with England in pledging themselves to the enterprise as a government undertaking. The proposed route with surface distances involved, is shown on the accompanying map, and is from Vancouver to Fanning Island, thence to the Fiji Islands, thence to Norfolk Island, and from there bifurcating to New Zealand and Queensland. Since a Pacific cable will at last complete the telegraphic circuit of the globe, it will give the peculiar advantage of placing each point thereon in cable connection with every other point by *two* distinct routes either east or west.

The cardinal idea in the British system has been that all state cables shall touch only British soil, and this principle has placed British cable traffic in the Pacific forever at a disadvantage over the American cable for the reason that the only available route involves a single span of cable from Vancouver to Fanning Island, over 3500 miles in length; whereas, by the annexation of the Hawaiian Islands, the United States, while following a similar principle, will have no span longer than the present Atlantic cables, or about 2500 miles in length.

Since the speed of cabling decreases in general with the square of the length of the cable, and the speed of the whole system is limited by the speed of the slowest span, that system requiring the longest single span is ultimately at a disadvantage, provided the systems are

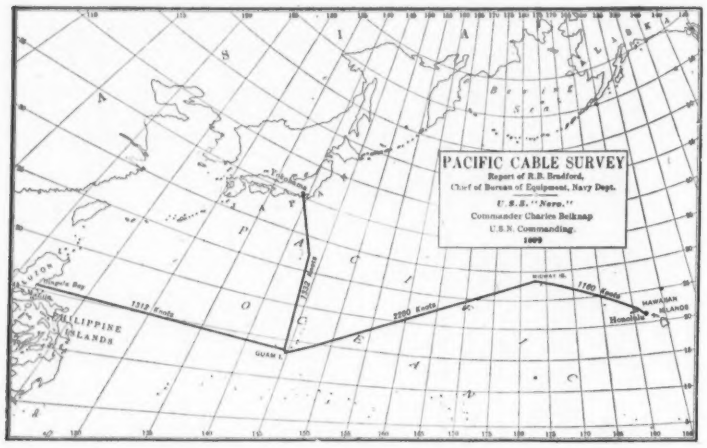


FIG. 1.—MAP OF PACIFIC CABLE SURVEY.

in direct competition. In the projected Pacific cable enterprises, however, although, as will be pointed out later, they will operate in close relations with each other, each has a sufficient prospective traffic to guarantee the enterprise as a sound financial success from the beginning.

The author then drew attention to the proposed northward route via Alaska, thence to Japan and Asiatic Russia, but which made no provision for American communication with the Philippines except through 1200 miles of foreign territory; besides which, the Great Northern Telegraph Company, of Denmark, had exclusive rights along the Siberian coast. There were various other objections to that route, from the American standpoint. He then discussed the route of the United States Pacific Cable as shown in the accompanying map, which gives also the data of distances furnished in the paper. The route includes a submarine mountain rising from the floor of the ocean 2200 fathoms deep to 82 fathoms of the surface; and a submarine abyss over 4900 fathoms deep. Capt. Squier pointed out that the longest span was only 2286 miles, while the French Brest-Cape Cod cable is 3250 nautical miles. Wake and Midway Islands, though mere atolls a few feet above the sea, were superior in this respect to Fanning Island.

As to cost and maintenance, of the eleven cables spanning the North Atlantic, the Anglo-American Company's cable laid in 1894, and the Commercial Cable Company's cable No. 3 laid also in 1894, have the greatest speeds. The former contains 650 lbs. of copper and 400 lbs. of gutta-percha, and the latter 500 lbs. copper and 320 lbs. gutta percha per nautical mile. Either of these types of cable would give good results and no cables of less equivalent speed should be considered. The following conservative estimate is made from the evidence obtainable relative to the establishment of this enterprise by the government on a sound financial basis:

MAINTENANCE AND REPAIR PER ANNUM.

Annual expenses of two cable repair ships	$200,000
Annual expense for new cable, assuming entire cable to be replaced in 40 years, or 200 miles per year	200,000
Working expenses	125,000
Reserve fund, and interest on capital	400,000
Total net earnings of cable required	$925,000

This provision for laying 200 miles of new cable per year should

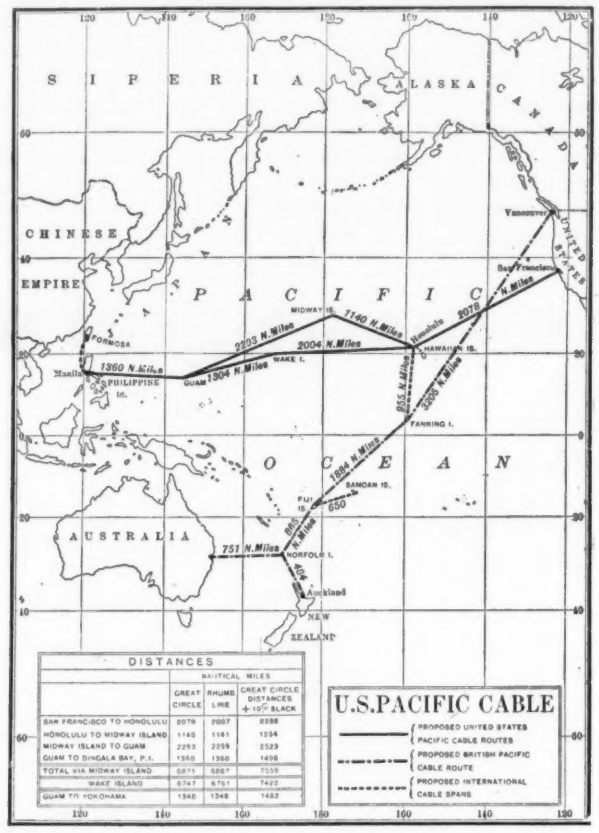


FIG. 2.—MAP OF PROPOSED PACIFIC CABLE ROUTES.

perpetually maintain the value of the cable as an asset, and the reserve fund further provides that the entire capital shall be replaced at the end of fifty years, or what is equivalent, that a sinking fund shall be established, which, at the end of fifty years will be sufficient to lay an entire new cable in addition to the permanent maintenance of the original one, so that at the end of fifty years two working cables will be provided for .

Taking average conditions for long cables ten years ago, the annual expenses for maintenance and repair, e .g., for new cable required, etc., and not including the fixed expenses such as the repair ships, was about $30 per nautical mile. The cost of such work is lower now.

Assuming 30 per cent. for "dead" traffic, and an increase of 90 per cent. of speed for duplex working, it is estimated that the maximum capacity of the cable in total paying code words, or eight words each, would be about 11,800,000 per annum. The cost of maintenance and operation, etc., as above being $925,000 per annum, the average cost of transmission per telegraphic word is about .08 cents.

*Abstract of a paper read before the American Institute of Electrical Engineers, New York and Chicago, Dec. 27, 1899.

The present commercial rate from Washington to Manila is $2.38 per word, government rate $2.255 per word, and the rate for "right-of-way" messages three times the normal rate.

It is seen that at the present commercial rate to Manila, after allowing for present land rates to San Francisco, the proposed cable is required to operate less than fifty minutes per day in order to earn the income of $925,000 per year. Allowing the present rate to be reduced one-half, the cable would have to work less than two hours daily. If the rate per code word, of an average of eight letters, is placed at 50 cents from San Francisco to Manila, then, upon the above supposition, the cable need operate daily less than four hours to meet expenses.

The Secretary of War says in his annual report: "The cable tolls of the War Department messages alone to and from the Philippines for the last five months have averaged monthly a rate of over $325,000 a year." This does not include the expenditure of the Navy and Foreign Departments. No data is yet available as to the expenditure of the newspapers.

This alone equals the interest at 3 per cent. on the sum of $10,845,000. It is reasonable to assume that the despatches of the other departments of the government would at least increase this amount by one-quarter, which would make the present government cable tolls to and from the Philippines equal to the interest at 3 per cent. on approximately $13,500,000. Fully 90 per cent. of this sum goes to foreign corporations while all Pacific cable expenditures would remain in the United States.

The author believed heartily, for reasons which he gave, in making the cable a government enterprise, and held that a large amount of matter now sent in the mails could be put into the cable at slack hours and at low rates, to keep it full and busy, with only the extra cost of the terminal operators.

A Native Indian Dynamo Tender in Central America.

The installation and operation of such apparatus as steam and electrical machinery in tropical regions presents a great many difficulties that are not apparent to any one who has not lived in such regions, but perhaps the greatest trouble of all lies in securing good, steady intelligent labor. The responsibility thus thrown on the management is very great and ofter leads to invaliding the official in charge, or to the importation of skill from Europe and America at high wages, with frequently very unsatisfactory results.

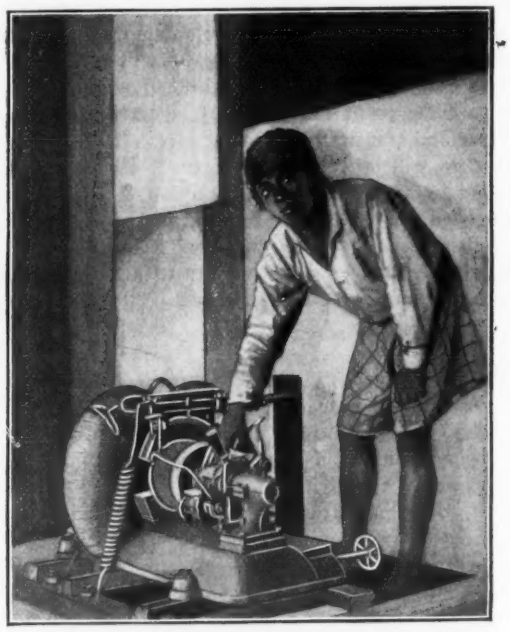


FIG. 1.—NATIVE INDIAN DYNAMO TENDER.

When therefore the apparatus is so simple, well built and handy that it can be entrusted to uneducated, untrained native help, a great deal is gained in opening up a market and in the development of industries.

In the Far East this problem of mechanical labor is not so great as it is in Central and South America, where the natives, often aboriginal Indians, have little inclination to give their days and nights to the study of engineering problems, and where the ease of living confirms their characteristic indolence. A great deal of American machinery is now pouring into Latin America, and its care is worrying those who ship it and those who have to operate the plants. We illustrate herewith one of the instances in which the machinery is successfully placed in the hands of a native Indian. The plant was installed by Mr. C. Fowler Charliss, to whom we are indebted for the photographs. He is the agent in Guatemala for the C & C Electric Company, and has now a large number of

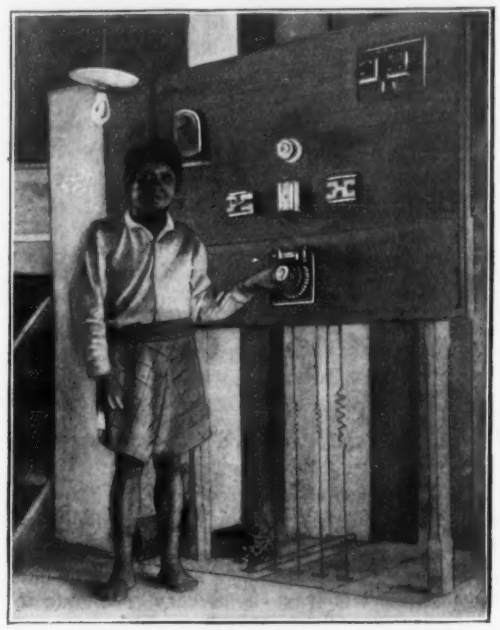


FIG. 2.—AT THE SWITCHBOARD.

plants of that system in successful operation on sugar or fruit plantations in that part of Central America. His help is almost entirely native Indian. In each case, one of the most intelligent men is selected to receive instruction and take practical charge of the plant. Mr. Charliss states that the machinery being simple, strongly built and not liable to get out of order, these youths and men show themselves quite competent to take care of it and keep it in good shape.

The special plant shown in our illustrations is a small 8-kw C & C outfit installed by Mr. Charliss on a sugar plantation. He speaks of the Indian shown in the pictures as unusually bright.

The Trolley in Connecticut.

The annual report of the Connecticut Railroad Commission shows that the trolley railroads of the State carried last year 59,084,702 passengers, as compared with 50,269,468 carried by steam roads. There are 442 miles of trolley roads in the State, an increase of only 29 miles, indicating that trolley territory has been almost exhausted. Capital stock of trolley companies is $12,715,948, an increase of $2,264,908, the stock issued for cash being only $4,202,440. Bonded debt is $10,608,800, an increase of $586,000, and floating debt $1,341,314, an increase of $582,486. Fifteen out of 31 trolley companies in the State paid dividends of $343,100 on $9,940,000 of capital, while no dividends were paid by 16 companies on $2,775,948 of capital.

The commission says that trolley cars are often run too fast for safety, and suggests some safeguards, but, in general, as regards criticism, the report is colorless. Comparisons of trolley operation and returns with those of 1898 is impossible, as the commission's figures for that period only cover a term of nine months. The most striking feature of the trolley returns is its showing of watered stock, $12,715,948 of outstanding stock, with $4,202,440 paid in as cash, contrasting with $10,451,040 outstanding stock and $4,038,440 paid in as cash in 1898. The increase is due chiefly to recapitalization of the Fair Haven and Westville Company.

The commission has ordered the trolley roads, after June 30, 1900, to adopt the system of street railway accounting approved by the last national convention of railway commissioners, acting with a committee of the Association of American Street Railway Accountants.

Independent Telephone Lines for New York State.

One of the first steps to be announced by the independent telephone interests for the construction of lines throughout New York State is the incorporation, at Albany, on Dec. 20, of the Farmers' and Merchants' Telephone & Telegraph Company, of New York City, with a capital stock of $100,000. The route will cover New York State. The directors are: John H. Farrell, Albany; George Sheppard, Pittsburg; George W. Beers, Fort Wayne, Ind.; Ezra M. Higgins and J. George Kaelber, Rochester; Titus Sheard, Little Falls; Edward F. Murray, Troy; and Robert E. Drake and George W. Pulver, Syracuse.

Another concern that is evidently formed to work in accord with the above is the Rensselaer Telephone & Telegraph Company, also just incorporated with a capital of $150,000. The company intends to operate lines in the cities of Troy, Renssalaer, Cohoes, Watervliet, and Schenectady, and the villages of Bath, Waterford, Lansingburg, and Green Island. The directors are John H. Gleason, Edward F. Murray, John J. Smith, E. E. Summy and Charles Mahoney, of Troy.

Electricity in China.

In a recent paper read before the English Society of Mechanical Engineers, Lord Charles Beresford said: "I learn from the ordinary channels of information that since my return from China it has been rendered possible for the traveler to go from the railway station to the gates of Pekin by electric traction. I, personally, was carried into the city in a mandarin's chair, while my staff rode on Chinese ponies, and, judging by the then state of the roads, to have so soon laid and started an electric tramway is very creditable to the promoters of the enterprise. In the European settlements electricity is already used for lighting purposes, and even at Hankow, 600 miles up the Yangtse river, some of the firms were laying down electrical plant. The abundance and cheapness of coal will render this branch of industry—electrical engineering—a very profitable one in a short time. The Chinese of the better class are very fond of luxury after European modes, and I have no doubt that they will be ready consumers of electrical power for lighting and manufacturing purposes. Of course, all the plant must, in the first instances, be imported, and I would like to point out to this institution that we are far behind Japan and America in the use of electrical power, and unless we are much more energetic the vast electrical plant which China will require will come from those countries. It is more than probable that Japanese and American engineers who accompany the plant to China will be employed there hereafter instead of British engineers.

"At Kioto, in Japan, I saw the great electrical plant which, in addition to lighting two-thirds of the town, also supplied the machine power for the city trams, for the pumping machinery at the water works, and for no less than sixty different industries in or near Kioto. The electric energy is produced by water power from a fall of 120 feet. The plant is chiefly American, but the Japanese are now beginning to make their own.

"Telegraphs already exist all over China, and are the Government property. They are badly managed. I was credibly informed that it is often possible to go from Pekin to Tientsin and thence to Shanghai, and to arrive before a telegram you had dispatched at starting. By paying treble rates it is possible to get reasonable speed, but the service is very inferior. Telephones exist in some of the settlements, but one manager of a telephone company in China told me that all their copper wires were stolen by the Chinese, so that they had a very inefficient service with steel wires."

CURRENT NEWS AND NOTES.

TELEPHONE TAX.—A new ordinance in San Francisco taxes slot telephones $1 per quarter, and requires that the desired connection be made before the patron drops his coin into the slot.

SUNDAY CARS.—Two trolley-car motormen of Boston have been suspended from the congregation of the Broadway Tabernacle Church of that city for running their cars on Sunday. When the young men got their jobs they were warned by the pastor not to work on Sunday. They applied for that day off, and were refused.

WIRELESS TELEGRAPHY IN WAR.—It is stated that the use of the Marconi system of wireless telegraphy in the war in South Africa has proved that cannonading does not interfere with the transmission of messages. The apparatus has been worked successfully and messages sent while the largest guns in the British navy were being fired.

DEATH OF AN INVENTOR.—A despatch from Fox Lake, Wis., states that Dr. E. J. Finney, "the inventor of the trolley system of propelling street cars" died in that place on Dec. 19. It is stated that he held over thirty-five electrical patents, many of them of great value, but he did not possess the faculty of making them pay him much money. He was formerly a practicing dentist at Pittsburg.

BOER TRENCH LIGHTS.—The Modder River correspondent of the *Daily Chronicle* gives an explanation of a sudden rifle fire inexplicably opened from the Boer trenches. He says: "The Boers have wires stretched along the ground in front of the trenches and connected with lamps. If a wire be touched a lamp is extinguished, thus giving warning. One night a high wind extinguished a lamp, which resulted in a false warning. The fire ceased when the Boers discovered that the alarm was false."

ABSOLUTION BY TELEPHONE.—Rev. Arthur Divine, a Passionist father and a recognized authority of orthodox Catholic theology, in his book entitled "The Sacraments Explained According to the Teaching and Doctrine of the Catholic Church," advances the opinion that the telephone may be used in confession, though he says that the matter has not yet been officially decided by the Pope. His opinion is that "a priest might give absolution by telephone, under condition, to a person taken suddenly ill, so as to be in imminent danger of death."

POTOMAC RIVER WATER POWER.—Active work is in progress by the Great Falls Power Company to utilize the water power of the Potomac River at that point for the purpose of generating electricity to be used in Washington, D. C., for lighting purposes, for the operation of street railways and for power uses generally. It is expected that the machinery will be in place and that electricity produced at the Great Falls will be in use in the city in the course of the next eighteen months or two years. Between $2,000,000 and $3,000,000 will be expended in developing the enterprise. It is estimated that between 10,000 and 12,000-hp will be available, and it is proposed to carry the current on overhead wires along the Virginia shore to some point near the city, where it will be brought across the river and transmitted into the city. It is claimed that the current furnished will be sufficient to operate all the street railroad lines controlled by the Washington Traction & Electric Company. The power needed for the electric lighting of the District will come, it is said, from the same source, and also, it is thought, there may be some left which can be sold for manufacturing uses and for every purpose which needs power. The plant will be located some fourteen miles from the city.

A COMPLICATION IN THE PHILIPPINE CABLE QUESTION.—A Washington despatch states that the Eastern Extension Cable Company has submitted, through the British government, claims for subsidies allowed in the concessions granted by Spain, and has protested against the laying of cables in the Philippines by the United States. Before the treaty of peace was signed the cable company questioned the right of the United States to lay cables in the Philippines, and demanded that this government should wait for cable facilities until the archipelago came into its possession by the treaty. The government decided that it had a right to lay war cables in any part of the archipelago, and fitted out the Hooker for this purpose. It is understood that General Otis will fit out another transport to take the place of the Hooker, which was wrecked at the entrance of Manila Bay. According to the despatch it is evident to the authorities that before action can be taken in the matter of laying a Pacific cable the question of the concession of the Eastern Extension Cable Company must be determined. Should it be decided that the concession must stand, Congress will have to make an appropriation in addition to the cost of the Pacific cable proper for the purchase of the Philippines cable concession.

TWO PER CENT. falling off in gas production in Boston is alleged, as a result of electric light competition.

VENICE, it is said, is to have a fleet of electric launches, as proposed a few years ago. The electric launches work very well in the canals of that interesting city.

ELECTRIC POWER ON STEAM RAILWAY.—It is reported from Chicago that the Chicago, Milwaukee & St. Paul Railway Company on Jan. 2 applied to the Chicago City Council for provision to operate its suburban train service by electric power. The third rail system will be adopted.

THE PARIS EXPOSITION.—Prof. Benjamin D. Woodward, Assistant United States Commissioner General to the Paris Exposition of 1900, took official possession on Dec. 27 of the spaces allotted to the United States in the Buildings of Machinery and Electricity. There was no ceremony. Mr. F. E. Drake, Commissioner of Machinery and Electricity, is to sail for Paris this week.

ELECTRICITY IN BERLIN.—A recent special despatch from Berlin, Germany, says: The Province of Brandenburg will issue a loan of 12,000,000 marks for the construction of subsidiary railways, and the City of Berlin will build an extensive system of underground railways. In the course of a fortnight a number of heated motor cabs will be running in the streets of Berlin. The fuel used will be carbon, electrically heated.

STORAGE CARS IN BERLIN.—A cable despatch from Berlin of Dec. 26 says: "There has been another heavy snowfall in Germany to-day, and street traffic is greatly impeded. One lesson from the severe snows of the last two weeks is that the accumulator electric car system is a failure. The Berlin lines will substitute overhead wires." Another despatch states, however, that the trolley lines have been in an equally bad predicament.

TELEPHONE ATTACHMENTS.—A patent was granted Dec. 26 to Daniel Queen on a telephone attachment for lines comprising a plurality of instruments, consisting of a device attached to a receiver whereby the transmitter cannot be replaced on its hook until the subscriber has broken the ground circuit. In a patent issued the same date to John T. Schoenleber, an attachment is described for use on intercommunicating telephone systems, having for an object to automatically prevent the circuit-selector switch being left out of normal position. This is accomplished by means of an attachment to the receiver hook which prevents the receiver being hung upon its hook until the selector-switch is in its normal position.

MARCONI AND THE TRANSVAAL.—A special despatch from Europe says that a correspondent learns that the wireless telegraph instruments recently captured from the Boers and described as Marconi's were not his manufacture. They were made by a well known German firm, whom Marconi once employed to experiment with plans he afterwards discarded. Marconi declares the instruments captured were not workable. Some feeling has been caused against the young inventor by the first report, the belief spreading that he had broken his agreement to supply only the British army during the war between the British and Boers.

PRIMARY BATTERIES.—Two patents were issued Dec. 26 to John Post on primary batteries. One patent is on an excitant for primary batteries, composed of a solution of pulverized charcoal, glucose, hydrochloric acid and sucrose in approximately equal parts, in 98 per cent. of water. The second patent is on the construction of the casing of a primary cell for use with electric vehicles, etc. The casing proper is made to rest in a cylindrical socket, and consists of a cylinder of hard rubber with a watertight cover screwed thereon. In the interior is a cylindrical carbon electrode with interior corrugations; the carbon is provided with a conductor passing through the bottom of the casing where it makes a contact at the bottom of the above-mentioned socket, to which the positive lead is secured. A zinc bar passes through the cover into the carbon cup. The zinc bar, which can be drawn up out of the liquid makes contact with a conducting sleeve on the cover, and to this sleeve the other battery lead connects.

ANOTHER HUNTER FUNDAMENTAL PATENT.—A patent was issued Dec. 12 to Rudolph M. Hunter on an application filed Oct. 27, 1886, which purports to fundamentally cover the electric automobile and also some forms of electric railway trucks. The patent contains 26 claims, of which the following is a specimen: "In an electric car, the combination of axles, a frame carried upon the axles and separated from the vehicle body, a vehicle body supported on springs, an electric motor to rotate the axle and so as to be substantially balanced upon said axle, and a connection between the motor and frame independent of the vehicle body or its supporting springs." In the specification it is stated that the characteristic feature of the invention consists in supporting the motor upon the axle and sustaining it by a frame also carried by the axle, whereby the motor is both geared and journaled to an axle and sustained independently of the car body. The motor is preferably journaled upon the axle by suitable bearings arranged at a considerable distance apart so as to permit the motors to move more or less around their respective axles as centres, the free ends of the motors being flexibly supported.

ENGINEERING DEGREES AT THE UNIVERSITY OF ILLINOIS.—The faculty of the University of Illinois recently decided upon the following conditions concerning the granting of professional degrees: The requirements for the second degrees of A. E., C. E., E. E., M. E., and M. Arch., include practical experience, professional applications, or experimental investigation along the line of the principal study or studies upon which the baccalaureate degree was earned, and the work offered must be high in grade, substantially original in design and execution with the applicant, and show such satisfactory proof of advancement as to partially qualify the candidate for membership in the national society representing that branch of engineering in which he seeks a second degree. In lieu of one year of post-graduate study in residence at the university, or of three years of similar study *in absentia,* the candidate for the second degree in engineering may submit for approval the result of at least three years of work and experience in the actual practice of his profession in that branch of engineering in which he is a candidate for such second degree; but such engineering work must have been done after receiving the baccalaureate degree, and during at least one year the applicant shall have been engaged in responsible charge of work. Satisfactory evidence as to the nature and extent of the candidate's professional experience is required to be submitted to the dean of the College of Engineering, who may direct that oral or written examinations be held regarding the candidate's competence and experience; but in all cases, when the candidate's experience is not in the same branch of engineering as that in which he took his baccalaureate degree, the dean shall direct that examinations be held. Considerable correspondence on the subject of engineering degrees was published in these columns in recent issues.

STORAGE BATTERY.—A patent was issued Dec. 26 to Charles Lindenberger, on an improvement in a storage battery, having for an object to provide a cell of light yet strong construction and with the elements so arranged as to afford a maximum surface area within a minimum space. The casing of the cell is of a conducting material, preferably aluminum, and comprises a tray-like lower portion and a cover insulated therefrom by a soft rubber band interposed. From the side wall of both upper and lower portions of the casing are projecting strips forming the positive and negative electrodes. Arranged around and against the inner surface of the side walls of the tray-like portion is a lining of hard rubber extending into the cover space. Within the interior of the rubber lining are the battery elements, which are composed of strips or ribbons of sheet lead perforated in such a manner that projections are formed upon one side and a corresponding opening upon the reverse side. These strips are coiled into a square form, the projections serving to separate the surfaces of the coiled strip, and the spaces thus formed are filled with active material. Two flat coils of this kind form an element, one being placed on the bottom of the lower part of the tray and separated from the other element by sheets of asbestos paper and absorbent pads. After the elements are placed, sufficient pressure is applied to seal the casing, and the whole is then immersed in melted paraffin, which serves as an exterior insulation and perfects the sealing process. It is claimed that this arrangement of parts prevents the possibility of buckling, change of shape or dropping out of the active material, and also allows the elements to be placed close together, thereby reducing the internal rersistance to a minimum.

LORD KELVIN AND THE TWENTIETH CENTURY.—Considerable discussion has been going on in the columns of the daily papers as to when the twentieth century begins—on Jan. 1, 1900, or Jan. 1, 1901. The same question is the subject of earnest discussion in the columns of the English papers, and in a London despatch Lord Kelvin is named as one of the most distinguished "victims of the delusion that the century begins on Jan. 1, 1900."

IMPERIAL PLANT, ST. LOUIS.—With regard to the station of the Imperial Electric Light, Heat & Power Company, St. Louis, recently illustrated and described in these columns, we have been requested to state that the station was built by the Arnold Electric Power Station Company, according to plans prepared by them under the supervision and approval of Bryan & Humphrey, the consulting engineers for the Imperial Company.

ALCOHOL AUTOMOBILES.—A number of automobiles in St. Petersburg and Moscow, Russia, are operated by motors using alcohol as fuel. Alcohol has, according to reports, been found to work most satisfactorily. It is stated that such fuel can be manufactured at a cost as low as eight cents a gallon. There is no present possibility of this fuel becoming available in the United States, since the internal revenue tax upon such alcohol would amount to about 90 cents a gallon. This of course makes it prohibitory.

THE GOVERNMENT AND WIRELESS TELEGRAPHY.—In last week's issue reference was made to the decision of the Navy Department to conduct its own experiments in wireless telegraphy and abandon Marconi's proposition. It is now stated that the Navy Department and the Lighthouse Board of the Treasury Department are endeavoring to arrange for the establishment of wireless telegraph stations on lighthouses and lightships in the United States. It is probable that a series of experiments will be conducted on naval vessels and in the lighthouses to ascertain how the system may be improved before there is any attempt made to install it. The experiments to be conducted at Newport under the charge of the Naval War College are to be distinct from the more general tests to be made by co-operation on the part of the Navy Department and the Lighthouse Board as above indicated.

CONSTANT POTENTIAL SERIES ARC LAMPS.—At the December meeting of the Société Internationale des Electriciens at Paris, M. Gosselein read a paper on "Arc Lamps in Series on Constant Potential Circuits." He recalled that in early installations two lamps were used in series on 110-volt circuits, a resistance being necessary in circuit for regulation. In 1889 the Schuckert Company produced a lamp which worked three in series on 110-volt circuit without any resistance. In France several have recently been working on this branch of arc lighting and MM. Vigreux and Brillie have constructed lamps which work three in series without resistance on 110-volt circuits. It is doubtful if there is any gain in light by substituting three lamps for two, though the reduction of the difference of potential at the arc permits the diameter of the carbon to be reduced and consequently increases the light to a certain extent. In the discussion M. Aliamet stated that he did not think that arc lamps would perform properly with no resistance in circuit.

LETTERS TO THE EDITORS.

Death by Electricity.

To the Editors of Electrical World and Engineer:

Sirs:—In the footnote to my paper in your issue of Dec. 30, 1899, a rather important typographical error exists which should be corrected. The sentence beginning "For instance 6 amp.," etc., should read: "For instance six-tenths of an ampere," etc., which is, of course, a much weaker current. R. H. CUNNINGHAM, M. D.

NEW YORK.

Power Factor and Difference of Phase.

To the Editors of Electrical World and Engineer:

Sirs:—As the writer of the article on "Power-Factor," referred to in your editorial in the issue of Nov 25, perhaps you will allow me to comment on your remarks. The statement that if the power-factor is unity then there is no difference of phase between the current and the e. m. f. may require no proof, but it certainly requires explanation. What do we mean by difference of phase?

To show that some definition is necessary we will consider a practical case. If we oscillograph the current passing through, and the potential difference between, the carbons of an alternating current arc, we find, as might have been anticipated, that the current and the potential difference both vanish at the same instant and are therefore exactly in step with one another. The power-factor, however, varies in an extraordinary manner with the kind of carbons used. With hard carbons on certain circuits it may be as low as 0.6 and with the best cored carbons it may be as high as 0.99—in fact, it is almost impossible to distinguish it from unity. Now in the paper referred to, it is proved that if the power factor were unity, then the ratio of instantaneous amperes is constant. If we then say that the power factor of the alternating current arc between given carbons is unity, we must be prepared to admit that the apparent resistance of the gaseous column forming the arc is constant. It was disbelief of this result that led me to examine the question mathematically and to satisfy myself that although it was almost impossible to distinguish between the power-factor of the arc with certain carbons and unity by direct measurement, yet the apparent resistance at any moment might fluctuate, as I knew from the oscillograph pictures that it did. For example, the power-factor between a parabola and a sine curve is 0.9995, yet the ratio of their ordinates fluctuates some 30 per cent.

Incidentally, this also brings out an important difference between "in step" and "in phase." If one e. m. f. wave were a semi-circle and another a parabola, their electrical difference of phase does not vanish even when they are "in step." If the latter curve were an ellipse the difference of phase would vanish when they are "in step." In order then that the "difference of phase" between two electrical waves be zero, the waves must stand on the same base and one must be a reduced copy of the other. If this proposition need proof, and I think it does, an algebraical proof, such as I gave in the London Electrician, would suffice. "Phase difference" has very little to do with physical considerations but a great deal with graphical convenience.

Again, in the second note, you say that the oblique angled triangle representing effective voltage, current and phase difference can be built up "from the right angled triangles representing the relations involved," and the problem is specially mentioned of an inductive divided circuit. In the *London Electrician* for Sept. 21, 1894, I have solved this problem in the way you indicate, taking mutual induction into account, but I was aware at the time that the method failed if any of the currents or e. m. f.'s did not follow the harmonic law. In this case we must fall back on solid geometry, and the graphical solution is one of great difficulty.

Thanking you, sir, in anticipation for allowing me to reply and assuring you that, if this letter helps anyone to understand "in step" and "in phase" better or induces anyone to give new names or better definitions as to what electricians mean by these things, I shall be well satisfied.

ALEXANDER RUSSELL.

LONDON, ENGLAND.

The True Explanation of Dark Lightning Flashes.

To the Editors of Electrical World and Engineer:

Sirs:—It very often happens that pseudo-explanations of phenomena are for a long time accepted without question or investigation. One example of this is the statement that the variation with direction of sound intensity from a tuning fork is due to interference. Another is the statement that the dark lightning flashes are due to reversal.

It is true that it has been shown that the images of spark discharges can be reversed by throwing the brilliant flash from a large quantity of magnesium powder against a white background. But no one accustomed to photographic work can admit that lightning flashes are reversed in this way. To quote from a previous letter in these columns (issue of Nov. 4, 1899),* "Dark flashes do not seem to be due to reversal, as we ordinarily understand the term, for

*Through a misprint in this article, April 20 being printed by mistake for April 29, a paper of mine on the subject of lightning flashes is made to antedate one written by Professor Thomson, while the reverse is the case.

we can have them with dark backgrounds; and when the flash crosses a mass of bright ones it does not show black, whilst if it were a reversal, it should persist as black for a little distance, until re-reversed." Through the kindness of Dr. Kennelly I have since obtained additional evidence of the statement. In the beautiful photograph given by him in his article (Nov. 28, 1899), it will be seen that part of the sky is quite bright and part quite dark. Now there are a number of dark flashes, too fine to show in the half tone, but very clear on the original negative, which cross both the light and dark spaces, and yet there is no change in intensity of the dark flash after crossing. If this were a true reversal effect, the flash would be darker over the lighted part of the sky, whilst this is not the case.

I had started to make some experiments on the subject, as I felt convinced that we had here no ordinary reversal phenomena, when a paper appeared by Prof. R. W. Wood, of Wisconsin University, in *Nature*, Nov. 30, 1899. In this extremely able and interesting paper, Prof. Wood shows conclusively that the effect is not due to reversal at all, but is an entirely new phenomenon. To quote his summary of his results, it appears "that the action of an intense light for a very brief interval of time decreases the sensitiveness of the plate to light." He shows conclusively that it is the suddenness, and not the presence of an illuminated background which causes the black flash.

REGINALD A. FESSENDEN.
ALLEGHENY, PA.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Hysteresis Loss in Armatures.—E. K. SCOTT.—An article in which he points out that Steinmetz's formula for the loss by hysteresis was originally found for transformers and should not be applied to the calculation of the hysteresis loss in armature cores, which is often given as the product of the coefficient of hysteresis, the 1.6th power of the magnetic induction, the number of pairs of poles, the number of revolutions per second, and the volume of the armature core, divided by the 7th power of 10. In a numerical example of a certain two pole dynamo he shows that such a calculation is of no use whatsoever. He quotes some statements of Ewing to the effect that the loss of hysteresis per magnetic cycle is different, whether the value of *H* is varied (as in a stationary transformer) or whether the iron core is revolved in a constant magnetic field (as in a rotating armature core), and that in accordance with the molecular theory, the loss in the first case is probably greater than in the second, especially when the field is strong. He refers also to the experiments of Bailey, who even found that a piece of iron revolving in a very strong magnetic field exhibits no hysteresis. Therefore the question whether Steinmetz's formula may be applied to armatures, depends upon the strength of the magnetic field in which the armature is revolving. For slotted multipolar armatures worked at a line density of 17,000 or 18,000 per square centimeter, and for Gramme armature cores worked at 17,000, the formula should not be applied, as these may be considered strong fields, while it may be more nearly correct for alternators worked customarily at a line density of 4000 in the main core and 9000 in the teeth. He adds the remark that it is possible that the discrepancy between the calculated result and the actual result may be due to mechanical vibration of the iron core, as Ewing has observed that if iron is kept in a state of vibration while under test, the hysteresis loss is diminished. He quotes some remarks of Fleming that one part of the duty of the field exciting current, is to keep on regenerating magnetization, because mechanical vibration is continuously tending to remove it, and asks the following question: "Does it not follow from this reasoning that, if a dynamo is coupled to an unbalanced engine—say one that knocks badly—the energy taken by the field coils would be increased? whilst, according to Prof. Ewing's observations, the hysteresis loss in the armature would actually be diminished!" Editorially it is said that what Ewing showed was that under sufficiently violent vibration a piece of iron would possess almost no retentiveness, and consequently during a slow cyclic process of magnetization the rising and falling curves could be compelled by vibration to come into practical coincidence, but that this is not the same thing as saying that no dissipation of energy is produced by the interactions of the magnetic molecules when a strongly vibrated piece of iron is being magnetized; he has only proved that whatever loss occurs, must be supplied otherwise than from the magnetizing current. As to the concluding question, the suggestion is contradicted that to simply maintain iron in a constant state of induced magnetization requires more energy when the iron is vibrated than when it is not.—Lond. *Elec.*, Dec. 8.

Hysteresis Loss in Armatures.—STILL.—A communication referring to the above article of Scott, pointing out that it seems generally to be admitted that the losses per cycle, due to a rotating magnetic field of a certain strength, are less than those due to a reversing field of the same maximum value, and that the fact that the hysteresis loss in a revolving disc begins to diminish when the induction reaches 16,000 or 17,000 c. g. s. lines per square centimeter, proves that Steinmetz's formula does not apply to dynamo armatures. Referring to the question of alteration in the core losses with changes of load, he says it would seem that in a dynamo armature the core losses might be expected to increase with the load, especially if the induction is comparatively low, on account of the crowding together of the magnetic lines due to the reaction of the armature field; it has been found experimentally to be correct in some cases, but not in others.—Lond. *Elec.*, Dec. 15.

Enclosed Motors.—WALKER.—A short outline of the development of the enclosed motor. The enclosed motor can be made a very efficient machine and has become a favorite in all cases where it is necessary to protect it against dust, etc. He discusses the disadvantages of enclosing and the means of surmounting them. There is a complete absence of ventilation for the armature; but the enclosing box itself represents a very good radiating surface. To perform certain work, an enclosed motor must be larger than an open one. In the enclosed motor, the matter of the brush gear and its regulation presents more difficulties than with the unenclosed motor. The oiling of the bearings must be carefully arranged lest the oil is thrown upon various portions of the insulation and forms a bed for copper and carbon dust from the commutator. The matter of temperatures and pressures within and without the motor chambers of enclosed motors, under ordinary working conditions and under extreme conditions should be carefully considered; also the capillary spaces in different parts of the chamber. He concludes that the enclosed motor has come to stay, provided it is designed as indicated, and that consumers will be quite willing to pay more for it when they appreciate the advantages.—Lond. *Elec. Rev.*, Dec. 15.

Enclosed Motor.—An illustrated description of a new enclosed direct current motor which is constructed with two large hollow field cores made of magnet steel and separate from the body on yoke casting; a large and effective additional cooling surface is thus provided for the field coils. There are slots cut through the pole faces extending to the outside which allow air of outside temperature to come into immediate contact with the revolving armature; the armature also causing a current of air to pass through the machine.—Lond. *Elec. Rev.*, Dec. 8; reprinted in *El'ty*, Dec. 27.

REFERENCES.

Synchronous Converters.—EBORALL.—A continuation of his article (Digest, Dec. 23). He discusses the use of such machines as double current generators. The installation of the Danube Steam Navigation Co., where such double current machines generate continuous current for lighting and three-phase current for the motors, is described; also the installation of the Chicago Edison Co. (Digest, Oct. 21.)—Lond. *Elec. Rev.*, Dec. 15.

Alternators in Parallel.—An illustrated article on the working of

alternators in parallel and on the methods of synchronizing; it seems to contain nothing new.—*Power*, December.

Theory of Alternators.—Blondel.—A German translation of the first of the French articles abstracted in the Digest Dec. 9.—*Zeit. fuer Elek.*, Dec. 3.

Lights and Lighting.

Reflecting Power of Electro-Deposited Metal.—Cowper-Coles.—A short article giving some notes on the amount of light reflected from various electro-deposited metals. The reflecting power, in terms of the square of the ratio of the reflected to the direct light, was found to be 0.94 for silver, 0.94 for chromium, 0.52 for platinum, 0.38 for palladium; the tests were made on plates prepared by chemically depositing silver on glass, and backing with an electro-deposit of copper, removing the deposit from the glass and finally coating the silver with the metal to be tested. Nothing is said concerning the polishing of the surfaces.—Lond. *Elec.*, Dec. 15.

Power.

Improved Efficiency of Engines.—An editorial on a device of Behrend and Zimmermann, by which it is claimed the output of a plant can be increased 50 per cent. without increasing the boilers or consuming more fuel. The fundamental idea is to combine a steam engine with a second similar engine which is operated by the vapor of a liquid of a much lower boiling point, such as sulphurous acid. This liquid is boiled in a separate basin by communicating to it a part of the heat contained in the exhaust steam from the first engine. and the vapor is used like the steam in the ordinary steam engine. This combination was devised ten years ago, but two experimental machines built at that time did not give satisfactory results. The practicability is, however, said to be proved now by an experimental investigation of Prof. Josse, of the Technical High School of Berlin. The two machines used by him are briefly described. The sulphurous acid was made to pass through a complete cycle. The normal steam consumption of the steam engine working alone was 19 lbs. per indicated hp-hour; when both machines worked combined, it was only 12 lbs. Prof. Josse claims that by such a combination made on large engines the steam consumption may be decreased to about 8.25 lbs. per indicated hp-hour.—*Elek. Zeit.*, Dec. 14.

Refuse Destructor.—Russell.—An abstract of a paper read before the Institution of Civil Engineers on the combination of such destructors and power plants. Details of ten combined plants are given in the original paper and these show that considerable energy can be obtained from the ordinary domestic refuse; the Shoreditch plant is discussed in detail, as it is the largest of its kind. The average amount received per day was 84 tons; electric power is used throughout the works; no coal is mixed with the refuse; the clinker residue is about 37 per cent.; most of the steam is used to drive electric generators. The average cost of burning the refuse during the second year was 62 cents per ton; about one pound of water was evaporated per pound of refuse; the total amount of energy sold by meters to consumers was 1,031,348-kw hours, of which about one-tenth was used at the destructor; the total amount burned was 26,201 tons; 1344 tons of coal were consumed. In this plant the charge for interest and redemption of land and plant was practically 25 cents per ton.—Lond. *Elec., Elec. Eng., Ind. and Iron*, Dec. 15.

Power Transmission.—An editorial discussing the article of Bell (Digest, Dec. 15) with special reference to the conditions in England. It is said to be probable that if bare high-pressure overhead transmission lines are to be permitted there, the limiting pressure would be fixed at some point between 10,000 and 20,000 volts. As to underground cables it is believed that if the Board of Trade does not fix a limit of extra high pressure at 10,000 volts, this limit will be exceeded in some of the new power transmission schemes there, as the radial thicknesses of insulation used for 10,000 volts would not have to be greatly increased to withstand 15,000, nor would the joining be any more expensive.—Lond. *Elec.*, Dec. 15.

Power Transmission Plant.—An illustrated description of the electric installation made to furnish a continuous supply of water to the San Joaquin Valley in Tulare Co., Cal., where the farming industry suffers periodically from the uncertainty of the rainfall. In the power house three 450-kw three-phase machines, direct coupled to water wheels, generate current of 440 volts and 60 cycles per second, which is transformed by four 500-kw transformers up to 20,000 or 34,000 volts, depending on whether their secondaries are connected on the delta or star system. The current is transmitted to various substations 30 to 40 miles distant, where it is transformed down and distributed, principally for the purpose of driving water pumping apparatus. The price for 1-hp per year has been fixed at $50.—*Elec. Rev.*, Dec. 20.

Power House for the Paris Exposition.—An illustrated article on this plant which will be divided into two approximately equal sections, one composed of French, the other of foreign machinery. The power required is estimated at about 20,000-hp, 15,000 being for light and 5000 for power purposes. Continuous current of 125, 250 and 500 volts, and single and three-phase alternating current of 22,000 volts an a frequency of 50 will be used. The units are not described.—*Power*, December.

References.

Utilization of Blast Furnace Gases.—The first part of a long article in which several attempts to utilize the gas are described. The fuel used in blast furnaces is considered and a typical analysis of blast furnace gas is given in a table. The pioneer plant in Great Britain, in which blast furnace gases have been utilized since 1894 to provide current for arc and incandescent lighting, is that at the Wishaw Works of Glasgow Iron & Steel Co. Since that time many large plants in Belgium and Germany have been started, as duly noticed in the Digest.—Lond. *Elec. Rev.*, Dec. 15.

Electricity in Rolling Mills.—The first part of an illustrated article, discussing the centralization of the generation of energy, the use of electric motors, the line, the transformers, and the starting of motors, for rolling mills.—*Elek. Anz.*, Dec. 10.

Cost of Steam Raising.—The first part of a reprint of the discussion which followed the papers of Holliday and Crompton (Digest, Dec. 16, 23).—Lond. *Elec.*, Dec. 15; the discussion at the second meeting in Lond. *Elec. Eng.*, Dec. 15; abstracted in Lond. *Elec. Rev.*, Dec. 15.

Horse-Power.—Rockwood.—A reprint of a paper on the value of a horse-power read before the Am. Soc. of Mech. Eng.—*Power*, December.

Traction.

Toronto Glen Grove Electric Railway.—An illustrated description of this new line which is interesting on account of the unusually heavy grades and the use of double current generators. There are two generators, giving 550 volts direct current on one side and 350 volts three-phase alternating current on the other. The direct current is fed direct into the line north to Newmarket, a distance of about ten miles. The alternating current is transformed to 10,500 volts and transmitted a distance of 16 miles to the substation at York Mills, where it is reduced by step-down transformers and synchronous converters to 550 volts direct current, at which it is delivered to the line for operating the southern portion of the road.—*Can. Elec. News*, December.

Railway Car.—An illustrated description of a new car for the Dublin tramway. It is a double-decked vestibule car, the winding staircase, at one end only, ascending in the vestibule for the protection of the passengers. The seats on the top are provided with a cover which is not shown; the length of car body is 16 ft. 8 in., the wheel base of the single truck is 6 ft., the seating capacity 25 inside and 37 outside.—Lond. *Elec.*, Dec. 15.

References.

Mountain Railway.—A description of the trolley line from Tuerkheim to Drei Aehren, in Germany, having a length of 5½ miles with a nearly constant grade of 6 per cent. For the return currents the rails and two separate cables are used.—*Elek. Neu. Anz.*, Dec. 1.

Easton-Bethlehem Tramway.—An illustrated description of this line, which is 12 miles long.—*St. R'y Rev.*, December.

St. Louis-Belleville Railroad.—An illustrated description of this double track trolley road.—*St. R'y Rev.*, Dec. 15.

Buffalo Tramways.—A long illustrated description of the system of the International Traction Co., of Buffalo.—*St. R'y Rev.*, Dec. 15.

Interurban Line.—An illustrated article on the passenger and freight interurban trolley road from Harvard, Ill., to Lake Geneva, Wis.—*St. R'y Rev.*, Dec. 15.

Return Railway Feeders.—Boehm-Raffay.—The continuation of the translation of his mathematical investigation, noticed in the Digest March 25, Aug. 26, Sept. 9.—Lond. *Elec. Rev.*, Dec. 8.

Tramway Brakes.—A comparison in parallel columns, of automatic air-brakes and direct compressed air-brakes, such as that of the Standard Air-Brake Co. The latter system is said to have all the advantages and none of the disadvantages of the automatic system for tramways.—*L'Elec.*, Nov. 18.

Automobiles.—De Centades.—The first part of an illustrated ar-

ticle on this year's competitive test of automobiles in Paris. In the electric automobiles the Fulmen accumulator was used exclusively.—*Cosmos,* Dec. 16.

Automobile Accumulators.—An illustrated German translation of the French article noticed in the Digest Dec. 30.—*Elek. Anz.,* Dec. 7.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Quarter-Phase vs. Single-Phase System.—GIRGENSOHM.—An article in which he endeavors to prove that a quarter-phase (two-phase) system with three wires is preferable to a single-phase system, even for lighting only. He starts with the statement that if the same type of machine is wound for one phase or for two phases, the power of the single-phase machine is not more than three-quarters that of the quarter-phase machine, and calculates that the maximum effect of a quarter-phase system, if all lamps are connected between the outers, is equal to the maximum effect of a single-phase system. He then considers the case that the single-phase and the quarter-phase systems are loaded with synchronous motors only and calculates the sum of the cross-sections of all conductors for both systems, when the lengths of the lines are the same and the power is consumed by the motors. He finds that the sum of the cross-sections for the quarter-phase system is then 1.33 times that for the single-phase system; and 1.09 times that for the single-phase system if four-fifths of the load is lamps and one-fifth motors. He claims that this proportion is still more in favor of the quarter-phase system, when the greater starting current of single-phase motors is considered, it being about three times that of two-phase motors. If single-phase generators are installed in a plant, he thinks it possible to install quarter-phase generators for extensions and to work single-phase and quarter-phase generators in parallel, the single-phase terminals and the outside terminals of the quarter-phase generators being connected to the same busbars for the lamps.—*Zeit. fuer Elek.,* Dec. 10.

Rheydt.—A short description of this new combined lighting and traction plant. For the lighting network a three-wire system at 2 x 220 volts is used, the conductors being underground with bare middle wire. Three 250-hp steam engines are direct connected to three dynamos. For light and power not more than 480 volts is used, while for traction 550 volts is necessary; the regulation of the engine is therefore so devised that by reversing a lever the number of revolutions is brought up from 92 to 100 per minute. "There is a storage battery of 270 cells with a capacity of 864 ampere hours for lighting and power purposes and a battery of 266 cells with a maximum discharge current of 198 amperes for traction work." At the opening of the plant more than 3000 lamps and 40 motors were connected.—*Elek. Zeit.,* Dec. 7.

Combined Lighting and Traction Plant.—A description of the new plant in Landsberg, Germany; 5200 incandescent lamps and motors of a total of 60-hp are connected, besides the power for traction. The cars are provided with the eddy current brake, described in the Digest, Dec. 30. For lighting, the three-wire system at 2 x 220 volts is used. Each of the three dynamos can be connected either with the lighting or the traction circuits.—*Elek. Anz.,* Dec. 7.

Bonn.—BAUER.—A very long illustrated description of this new plant, which is the first large German plant in which the continuous current three-wire system at 2 x 220 volts is used, with earthed bare middle wire and underground cables as outers. The advantages of the 2 x 220 volts system are discussed at some length. He calculates that on account of the smaller cross-section of the cable network, the cost of a 2 x 220 volts system is about half or two-thirds that of an equivalent 2 x 110 volts system, and points out the possibility to use the same dynamo type for lighting and traction. A disadvantage is that in the use of usual arc lamps, four are always to be connected in parallel, instead of two, as in the 2 x 110 volts system, if it is not preferable to use enclosed arc lamps burning at 110 volts, which has proved satisfactory in Bonn. The plant contains two 175-kw dynamos, giving 440 to 550 volts at 150 revolutions; a 430-kw dynamo, giving 440 to 550 volts at 125 revolutions, and an accumulator battery of 290 Tudor cells giving 540 or 700 ampere-hours when discharged at 180 or 75 amperes respectively. In case of accident to an engine, the battery may be discharged with 400 amperes, which is sufficient to furnish current for 3200 incandescent lamps of 16-cp. There are also two boosters coupled to electric motors of greater power than is necessary for driving the boosters, as they are to be used also for balancing. The network is calculated for 8000 incandescent lamps of 16-cp burning simultaneously. Motors below 2-hp are run at 220 volts, above 2-hp at 440 volts.—*Elek. Zeit.,* Dec. 7.

Perth.—A short illustrated description of the lighting plant at sumer's voltage from 110 to 220. The method of changing over is not clearly described, but it is stated that before the day set for the Perth, Western Australia, and of the process of changing the conchange, all the large consumers' premises and some whole streets, had been altered to 220 volts, and this facilitated the work, "as it was only necessary to first remove the outer wire from its socket at the corner of the street and put it in the middle wire socket, of course, to be replaced at a convenient opportunity and the proper balancing effected." There were about 80 places where the wire had to be changed from the outer to the middle and about 350 where the lamps had to be changed.—Lond. *Elec. Rev.,* Dec. 6.

Installation in the Fine Arts Building of Chicago.—An illustrated description. The current is supplied from the adjacent Auditorium power plant, to a switchboard in the basement, from which the light and power circuits for the entire building are controlled. It has ten circuits for light and five for power for supplying 4500 incandescent lights, eight arc lamps and 140-hp in motors. The present voltage maintained on all circuits is 110 volts, but the lighting circuits are adapted to be converted into a 220 volts system. The electrical features of the Studebaker Hall, a large concert hall occupying the greater portion of the first three floors, are described in detail, and the wiring of the theatre switchboard and fuse board is given in a diagram. All halls are ventilated by fans driven by electric motors. There are six elevators, each driven by a 15-hp motor directly connected to the worm of the hoist.—*West. Elec.,* Dec. 23.

Greenock Lighting Plant.—Some supplementary notes on the distribution system of this plant, a description of which was noticed in the Digest Dec. 30. For arc lighting single conductor vulcanized bitumen 7/16 cables are used, either drawn into Callender-Webber casing or iron pipe. The potential leads consist of three core 7/20 lead-covered cable, also drawn into casing.—Lond. *Elec. Eng.,* Dec. 15.

Hereford.—A description of this new English plant, in which the three-wire continuous current system at 2 x 220 volts is used. There are two shunt wound dynamos giving 200 amp. at 440 to 500 volts and a battery of 270 cells giving 660 amp.-hours at a 9-hour discharge rate. The present network has a capacity of 10,000 lamps of 8-cp.—Lond. *Elec., Elec. Rev., Elec. Eng.,* Dec. 15.

REFERENCES.

Central Station Costs.—Several of the English electrical journals publish each week statistics and analyses of the costs of operation of central stations in that country; these are not noticed separately in the Digest, as they are chiefly of local interest. The London *Electrician* publishes weekly an analysis of the accounts of two selected stations, accompanied by a convenient reference list to those previously published. London *Lightning* also publishes weekly a well filled table of costs of stations in the United Kingdom, as also an analysis with comments, of selected ones.

Stray Currents.—An article of a general nature discussing the disturbances of magnetic observatories by currents flowing in the neighborhood and the corrosion of iron pipes and iron structures by return currents of tramways.—Lond. *Eng'ing,* reprinted in *Elec. Rev.,* Dec. 20.

European Electrical Engineering.—An illustrated description of the plants in Rheinfelden, Switzerland; Nuremberg, Germany; Plymouth, Hull and Carlisle, in England, all of which have already been referred to in the Digest.—*Power,* December.

Batavia.—LIPPEGAUS.—A reprint of the article on electric traction in Java, noticed in the Digest Dec. 9.—*El'ty,* Dec. 27.

Car for Lighting Installations.—An illustrated description of generating plants on cars, as used on an Italian and a French railroad.—*Elek. Zeit.,* Dec. 7.

WIRES, WIRING AND CONDUITS.

REFERENCE.

Methods of Suppressing Arcs in Switches, Fuses, Etc.—E. K. SCOTT.—A continuation of the illustrated paper noticed in the Digest Dec. 30. He describes the Garton-Daniels arrester, the Wood arrester, the Sentinel circuit breaker, the use of choking coils on alternating current switches and the use of electrolytic polarization cells to prevent sparking; also the Mordey dust fuse, the Berend Smith fuse, the D. & W. fuse and the Bates high-tension switch fuse.—Lond. *Elec., Elec. Rev.,* Dec. 15.

Electro-Physics and Magnetism.

Difference of Potential and E. M. F.—Teege.—An illustrated article in which he emphasizes the importance of distinguishing between a difference of potential and an e. m. f. A case is described in which a constant current flows in a circuit, although there is no apparent difference of potential between any two points, which at first sight seems paradoxical; the magnetic field was formed of a hollow cylindrical north pole with a coaxial cylindrical south pole inside, the lines of force being therefore radial, and perpendicular to the surfaces in the angular air space between them; a closed circuit in the form of a ring is then moved through this air space in the direction of the axis, the plane of the ring being perpendicular to the axis, and if the speed is constant, a constant current will flow through it while it is cutting the lines of force. If now, any two points of the circuit are connected to a voltmeter so that the connecting wires do not cut magnetic lines, he says the voltmeter will not indicate any difference of potential. Ohm's law holds good, but in this case the difference of potential between the two points, defined as the work done by moving a unit of electric quantity from one point to another over any path, varies for different paths. Difference of potential should be spoken of only when the electric lines of force start from and terminate in free electric charges, and in this case the difference of potential has a certain value and is independent of the path. To prove his theoretical explanation, he describes some experiments in one of which there is an ordinary induction coil which is short circuited; if any two points on it are connected to a galvanometer there is a very small deflection when a magnet is inserted into the coil, while there will be a large one under the same conditions if the circuit is open.—*Elek. Zeit.*, Dec. 7.

Conductivity of Flames Containing Salt Vapors.—Wilson.—An abstract of a Royal Society paper, taken from the *Jour. Chem. Soc.* When two platinum gauze electrodes are placed in a flame into which a salt solution is sprayed, the current attains a nearly constant value, as the e. m. f. increases, provided both electrodes are hot; the current is much greater when the negative electrode is hot and the positive cool, than in the reverse case; the drop of potential near a cool electrode is nearly equal to the total, especially if it is the negative electrode. Nearly all the ionization of the salt vapor takes place at the surface of the electrodes, and the contact of fresh vapor with the electrodes, especially the negative, produces a marked increase of current. The positive ions Li, Na, K, Rb and Cs have nearly the same velocity, while the negative ions of various salts of these metals have a velocity about 17 times as great. The fact that the ionization of the salts takes place only at the surface of the electrodes, combines with the greater velocity of the negative ions, accounts for the phenomena of unipolar conduction.—Lond. *Elec. Eng.*, Dec. 8.

Action of the Coherer.—Malagoli.—A description of an experiment in which, at the bottom of a beaker filled with petroleum or vaseline oil, a metallic disc was placed carrying a layer of brass turnings; above this is a small metallic sphere, and both are connected to an influence machine. The first phenomenon observed is the "electric dance" of the particles discharging the electric charge by convection. On diminishing the distance between the disc and the sphere, a moment arrives at which a number of particles form themselves into a chain, welded together by the spark, while all the loose particles fall back on the disc. The phenomenon depends upon the dimensions and the fusibility of the particles.—*Nuovo Cimento.* October; abstracted in Lond. *Elec.*, Dec. 8.

Anode and Cathode Rays.—Battelli and Magri.—An account of a series of experiments in which they subjected the same highly exhausted tubes to bipolar and unipolar discharges. They found the following rules: In every species of tube both anode and cathode rays are generated, the former proceeding from parts at the higher potentials, the latter from parts at the lower potentials. In the case of bipolar discharges all parts of the tube generate anode rays, except the cathode which generates cathode rays only. But when only one electrode is connected with the machine, both anode and cathode rays are generated by the electrode connected.—*Nuovo Cimento,* October; abstracted in Lond. *Elec.*, Dec. 8.

Absorption of Röntgen Rays.—Blythswood and Marchant.—An account of an investigation made to find a relation between the absorbing powers of salts having the same acid radical. For the acid radicals, no relation could be found between their absorptivity and their atomic weights or molecular densities, the order of increasing absorption being nitrate, chloride and sulphate. For the bases, there is a rough correspondence between absorption and atomic weight, but the salts of the alkali metals are less absorptive than they should be.—*Proc. Roy. Soc.*, No. 421; abstracted in Lond. *Elec.*, Dec. 15.

Thermo-Couple Without Junctions.—Viles.—A short communication in which he tries to prove that the effect observed by him (Digest, Dec. 30) is really a thermoelectric one. The current continues as long as one-half of the loop is kept hot, and the direction of the current is reversed when the heat is transferred to the other side of the loop. If the wire be treated with selenium at two places a short distance apart, and the heat properly disposed, the current is nearly doubled, and the wire then acts like two thermo-couples in series.—Lond. *Elec.*, Dec. 15.

Diurnal Variation of Atmospheric Electricity.—Chauveau.—An account of observations made since 1893 on the Eiffel Tower, referred to in the Digest Nov. 4. He traces a curve showing the diurnal variation of the difference of potential between an elevated point and the ground. There is a maximum at 8 p. m. and another at 7 a. m., with minima at 3 a. m. and 4 a. m.—*Jour. de Phys.*, November; abstracted in Lond. *Elec.*, Dec. 8.

References.

Physics.—Very good abstracts of the more important papers on physics and electrical engineering that are published in the monthly journal, *Science Abstracts,* London; many of those on physics are of interest also to electrical engineers; a section on steam plants, gas engines and oil engines, and one on motor cars, including also those which are not electrical, are to be added. Most of those abstracts on electrical engineering and many of those on physics, are, as a rule, noticed earlier in the Digest, though often more briefly, and they will therefore not be again noticed in the Digest. The London *Electrician* publishes each week a few very good abstracts by E. E. Fournier d'Albe of some of the more important articles on electrophysics, from the leading French, German, Italian, English and American scientific journals; whenever the original has already been noticed in the Digest, these abstracts will not be again referred to.

Terrestrial Magnetism.—Van Bemmelen.—An account of measurements made during half a year in Batavia. He traced the seismic disturbances (earthquakes) in the magnetograms, and investigated certain periodic variations of the horizontal magnetic force of small amplitude and duration, which he calls "spasms."—*Proc. Roy. Akad. Amsterdam,* Oct. 28; abstracted in Lond. *Elec.*, Dec. 15.

Terrestrial Magnetism.—Folgheraiter.—An abstract of a French Physical Society paper on the secular variation of the magnetic inclination in antiquity.—*L'Elec.*, Nov. 25.

Electro-Chemistry and Batteries.

Voltaic Cells With Compound Electrodes.—Spiers.—The conclusion of the article noticed in the Digest Dec. 30. He applies his conclusions to explain the exact way in which the presence of zinc in boilers, when in metallic and liquid connection with the steel plates, diminishes the corrosion of the latter. There are two hypotheses, one supposes that the local current produced by the zinc merely acts indirectly to free the water from acids and such like impurities; the other assumes a direct beneficial effect of the presence of zinc on the difference of potential between the various metallic components of the boiler, such as the brass fittings and the steel. Both hypotheses may be true, but his experiments confirm the latter supposition. The corrosion, in general, is due to the current of electricity passing from the steel to any of the boiler fittings, usually brass, to which steel is electropositive; if a small piece of zinc is attached to a large plate of steel and this plate is suspended in a liquid as one electrode and a large plate of brass as the other electrode, there are three currents flowing through the liquid from the zinc to the steel, from the zinc to the brass, and from the steel to the brass. His experiments show that the effect of the zinc is to raise the potential of the brass plate relatively to the steel plate, so that the brass plate is relatively more electropositive than it would be if there were no zinc, hence less current will flow through the liquid from the steel to the brass, and less steel will be dissolved.—Lond. *Elec. Rev.*, Dec. 15.

Transition Cell.—Cohen.—A description of a cell, the electrodes of which are of the same metal in two different states, and the electrolyte is a solution of that metal. The metal used was tin, which has a transition point of 20° C., below which it is gray tin in the stable state, and above it, white tin; in the latter state it may be considerably "supercooled," thus admitting of a cell to be made of the same metal in the two states. The e. m. f. is a function of the electrolytic solution pressures of the two states. The cell is of theoretical

interest, as it enables the transition point to be accurately determined by heating the element until the e. m. f. becomes zero; the cell is of no practical value as a source of current.—*Proc. Roy. Akad. Amsterdam,* Oct. 28; abstracted briefly in Lond. *Elec.,* Dec. 15.

Aluminum.—A short article, with two statistical tables, on the development of the aluminum industry. One table gives the production of aluminum in Switzerland, England, France and the United States during the last nine years; the production in these countries was 40,538, 70,000, 37,000, 27,850 kgr. in 1890, and 800,000, 300,000, 500,000, 2,358,704 kgr in 1898. The second table shows the decrease of the price per kgr from $18 in 1896 to $0.54 in 1898.—*Cosmos,* Dec. 2.

REFERENCES.

Electrochemistry in 1898.—A continuation of the article noticed in the Digest Dec. 30, giving short descriptions, taken from patent specifications, of new electrolytic methods of producing sodium, calcium, beryllium, magnesium, aluminum, copper, gold, silver, zinc, tin, tungsten, nickel and cobalt, palladium; and of new methods of producing an alloy of copper with 5 to 10 per cent. baryllium and another of iron and 5 per cent. titanium in the electric furnace.—*Elek. Anz.,* Dec. 3.

Electrochemistry—The weekly German journal *Zeitschrift fuer Elektrochemie,* contains good abstracts of German, English and American patents on electrochemical processes, apparatus, batteries, etc. These will not be noticed specifically in the Digest.

Aluminum.—HENDERSON.—An abstract of a paper read before the Manchester Society of Junior Engineers, giving a general description of the properties of aluminum and of two electrolytic methods of manufacturing it.—Lond. *Elec. Eng., Ind. and Iron,* Dec. 15.

Copper Refining Plant.—An illustrated description of the electrolytic copper refining plant of the Boston & Montana Copper & Silver Mining Co., at Great Falls, Mont.—Lond. *Elec.,* Dec. 15.

Majert Accumulator.—A reprint with the illustrations, of the description noticed in the Digest Dec. 30.—*El'ty,* Dec. 27.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Measuring Instruments in High Tension Plants.—SCHUELER.—A well illustrated description of a method used by Lahmeyer in all installations where high voltages are generated direct by the machines without the use of step-up transformers. All instruments, voltmeter, ammeter, wattmeter, energy-meter and phase lamps are operated at low voltage in such a way that they are not in conducting connection with the high tension generated in the machines, so that they may be touched without danger. This is accomplished by connecting all the instruments to only a part of the armature windings which is not in direct connection with the rest, but is connected with the primary winding of a transformer, the secondary of which is connected in series with the balance of the armature winding. If the transforming ratio of this transformer is one to one, the current flowing through the ammeter is nearly exactly equal to the armature current of the machine. The arrangement is shown in several diagrams.—*Elek. Zeit.,* Dec. 14.

Instrument for Measuring the Frequency of Alternating Currents.—STOECKHARDT.—An illustrated description of a very simple instrument for measuring the frequency exactly, if its value is known approximately. The instrument consists of a wrought iron tuning fork and a coil with a soft iron core between the prongs. The prongs are provided with adjustable weights, so that the period of the oscillations can be altered. When adjusted so that the note of the fork becomes a maximum, the periodicity of the current in the coil is a multiple of that of the oscillations of the note. In the instrument described the adjustable weights on the fork are moved along a scale determined empirically and giving the value of periods between 90 and 120. The results of a test are given in a table and show that the instrument enables very sharp readings to be taken, the errors being below one-quarter per cent. (Two other methods to determine the frequency were noticed in the Digest Aug. 19 and Sept. 16.)—*Elek. Zeit.,* Dec. 14.

REFERENCES.

Magnetic Observatory.—STUPART.—A Canadian Institute paper describing the magnetic observatory at Toronto.—Lond. *Elec.,* Dec. 8.

Thermoelectric Measurements.—STRANEO.—An account of an investigation in which he tried to develop a practical method of studying thermoelectric phenomena by observing the temperature of the conductor itself.—*Nuovo Cimento,* October; briefly abstracted in Lond. *Elec.,* Dec. 8.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Telephony in Germany.—The reprint of the new German law concerning the price of telephone service. In an exchange of not more than 50 subscribers it is $20 per year; in one of 1000 to 5000, $40; in one of over 20,000, $45. If desired, the following rates can be chosen, in which there is a fixed fee and a price for each call; the fixed charge is $15 for exchanges of not more than 1000, and $25 for those of more than 20,000 subscribers; the charge for each call is 1¼ cent; at least 400 calls per year are to be paid for. The law is also discussed editorially.—*Elek. Zeit.,* Dec. 7.

Wireless Telegraphy.—A note on experiments made by Siemens & Halske with wireless telegraphy between a German mail steamer and a station on coast near Kiel. Telegrams were sent and received over 19 miles; for greater distances there were difficulties; atmospheric electricity was especially a source of disturbances, as no special arrangements were made on the steamer for the tests.—There is also a note on a lecture of Slaby on the development of wireless telegraphy, but it seems to contain nothing new. He pointed out that there is no difficulty in the practical use of wireless telegraphy and that mates on ships are able to learn to use it in a short time, as was proved by experience.—*Elek. Anz.,* Dec. 10.

REFERENCES.

Telegraph and Telephone Statistics.—The *Journal Telegraphique,* published monthly in the French language in Berne, Switzerland, contains what seem to be the most complete statistics published for telephony and telegraphy, for most of the countries, not including the United States; they are usually official. They will not, as a rule, be noticed specifically in the Digest.

Telegraphy in 1898.—Extended statistical tables for 1898 for many countries of the world, but not including the United States.—*Jour. Teleg.,* Nov. 25.

Telegraphy and Telephony in Great Britain.—A long abstract of the report of the Postmaster General for the period from April 1, 1898, to March 31, 1899.—*Jour. Teleg.,* Nov. 25.

Early Telegraphy.—An illustrated article on the development of telegraphy from 1790 to the middle of the present century.—*Cosmos,* Dec. 1.

French Cable Projects.—An article on some cable lines, chiefly European, Asiatic and African, projected and advocated by the French in opposition to the English cables; the estimated cost is $20,000,000.—Lond. *Elec.,* Dec. 15.

Telephone Exchange.—CLAUSEN.—An illustrated description of the power plant in a modern telephone exchange.—*Elec. Eng'ing* and *Tel. Mag.,* December.

Common Battery System.—TOBLER.—An illustrated description of the common battery system of the Western Electric Mfg. Co.—*Jour. Teleg.,* Nov. 25.

Telephone Patents.—The monthly journal, *Electrical Engineering,* contains in each issue an illustrated digest of U. S. patents on telephones and kindred matter, prepared by Clements.

MISCELLANEOUS.

Electric Seasoning of Timber.—MONTPELLIER.—A long, illustrated article on the Nodon-Bretonneau process, described in the Digest Feb. 25 and March 18. After introductory remarks on the composition of timber and on the different processes of seasoning, he gives some historical notes on the electric process and describes at some length the apparatus used in the plant at Aubervilliers, where this process has been exploited on large scale for some months, the current being produced by two continuous current dynamos, each of 35-hp. The average cost of seasoning in this plant by electrolytic treatment in troughs and drying in ovens is 7 cents per cu. ft.—*L'Elec.,* Oct. 7, 14, 21; Nov. 4, 11, 18; briefly abstracted in Lond. *Elec. Eng.,* Dec. 1.—An illustrated abstract of the French article on the same subject, noticed in the Digest Nov. 11, is given in *Sc. Amer. Sup.,* Dec. 23.

The Digest for 1899.—During the past year, which was the seventh year of this department, the number of journals abstracted was 1618, averaging over 31 per issue; of these, 852 were foreign and 766 American. The number of abstracts and references was 3470, averaging 67 per issue; compared with last year, the number of abstracts was greater, and the number of references less, thus making the department more of the nature of a true digest, as distinguished from a mere index. The largest number in any group was 623 under Traction; next comes Electro-Physics with 552, followed by Electro-Chemistry with 412.

REFERENCE.

National Museum.—TENNILLE.—An article on the electrical development as portrayed in the National Museum at Washington, giving a brief outline of the exhibits.—*El'ty,* Dec. 27.

New Books.

THE USE OF THE SLIDE RULE. By F. A. Halsey. New York: D. Van Nostrand Company. 84 pages, 18 illustrations, 6 plates. Price, 50 cents.

As stated in the preface, this little book is in the main part a reprint of a series of articles from the *American Machinist,* of which the author is associate editor. It is intended for an instruction book rather than a treatise, and we fully believe that it fulfils its mission, as it is clearly written and covers all important points. The engravings are true reproductions of the instrument, showing the same properly set for solving the various problems described. We heartily agree with the author in his warning against what he terms "slide-rule gymnastics." Since the slide rule is a most valuable labor-saving device, we recommend this little book to all who wish to become familiar with the merits of mechanical calculation.

Electric Trucks for Heavy Work.

In our first issue of last October attention was directed to the electric truck or 'ray for heavy work, designed by Mr. A. L. Riker and built by the Riker Electric Vehicle Company, of Elizabethport, N. J. So far as we are aware it is the first of its kind built in this country. It will haul six tons at a speed of two, three or six miles an hour. The truck itself, with motors, weighs 7,000 pounds, and the batteries 3000, the radius being twenty miles. There are two motors, and the batteries are carried in a box between the front and rear wheels, which are of wood with 4-inch solid tires.

We now illustrate another Riker truck or wagon of somewhat the same character, but of special design and built by the Riker Electric Vehicle Company for Schultz, the well known soda water

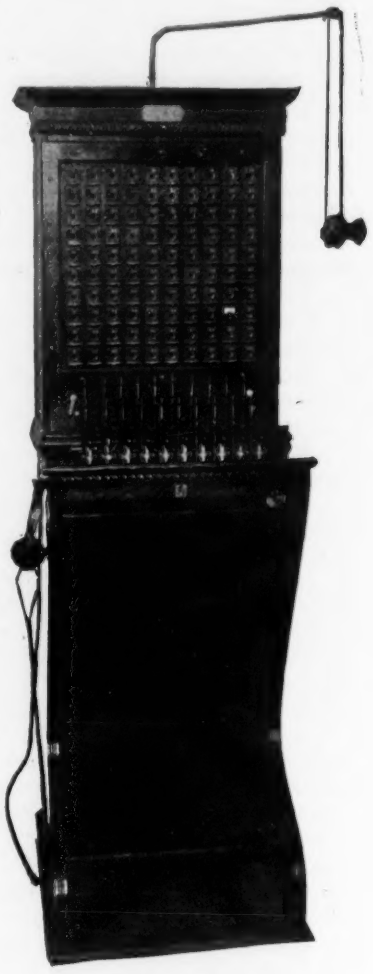
ELECTRIC TRUCK FOR MINERAL WATER DELIVERY.

maker of New York city. It is intended to deliver charged syphons, and will take a load of 2800 pounds up any grade in New York city. It has two motors of 4-hp. each, normal, and its batteries have a 30-mile radius. A speed of eight miles an hour can easily be made on the level. In this instance also the wheels are of wood with solid ruber tires, but as will be noted the batteries are entirely out of sight, there not being even a suggestion of their presence. They are encased in the boxes formed by the floor of the truck and the under tray holding siphons of mineral water. The truck steers with the front wheels, as usual in Riker automobiles, and the levers, controllers, etc., are all very handy to the driver, who could hardly wish for a neater, more convenient wagon for such work.

Novel Telephone Switchboard.

We illustrate and describe herewith a board which, it is claimed, embodies in its design and construction those features of simplicity, rapidity, accessibility and freedom from all kinds of crosstalk, without which telephone service is unsatisfactory to all concerned. The board is a 100 drop type A.

The cabinet is strongly made of thoroughly seasoned, selected, quartersawed oak and finished in a first class manner. The cords, house cable and all connections are made on the inside of the back of the cabinet, which is fitted with double doors provided with lock and key so that no injury can occur to these parts. The drops and jacks of the self-contained type are mounted on hard rubber and are held in position by a single nut. They are interchangeable and so constructed that the necessary connections, except those of the line, are automatically made when the jacks are placed in the board. The night bell contacts are positive, being made on the rubbing principle and are substantial and provided against injury.



100-DROP SWITCHBOARD.

The board is operated by means of cams for listening, and the ringing of a subscriber is accomplished at the same time the plug is placed in the jack of the party wanted. The shutters or drops are practically automatically self-restored when a plug is placed in a jack or removed from the same. The listening cams are placed in a dust-proof case and can be easily inspected at any time by raising the lid of the cam case, on the underside of which they are mounted.

The magnet windings are very novel in construction, the necessary wire being wound in the form of a helix which is slipped into its case upon the removal of the magnet armature and a fibre retaining disc. A burned out drop can thus be renewed in a few moments without the necessity of returning it to the factory. The operator's receiver and transmitter are of the latest improved type and are both adjustable in all directions.

A very important point in this board is the fact that it can be used either for strictly metallic circuits or common return or ground circuits with no change except connecting one side of each drop terminal to the common return or ground wire. Thus a common return system using this board can be changed over to metallic or vice versa with practically no expense as far as the board is concerned.

This board is made up in all sizes from one to two thousand drops and the drops are mounted in several types of cabinets to be selected by the purchaser.

The above mentioned apparatus is the result of years of careful study and experiment by the Connecticut Telephone & Electric Company, of Meriden, Conn., who manufacture it exclusively and who will be glad to furnish additional information to any who may be interested.

A New Party-Line Telephone System.

The Holtzer-Cabot Electric Company, of Boston (Brookline), Mass., is placing on the market a new party-line telephone system based upon an inductive signaling apparatus. Fig. 1 shows two stations, in which, for the sake of clearness, the signaling system

alone is shown. At each station a specially designed transformer is mounted in a magneto box. The transformer, shown in Fig. 2, is provided with two windings in the usual manner, the high-resistance winding being connected to the main circuit and the low-resistance winding to the local circuit, the latter including in series a low-resistance ringer and magneto generator.

FIG. 1.—DIAGRAM OF CIRCUIT.

When the generator is operated the ringer current divides, part going through the striker, *R*, and the remainder through the winding, *S*. The voltage of the latter portion is stepped up in the high-potential winding, resulting in a current of sufficient e. m. f. to operate the ringers throughout the system. When the calling current from this transformer reaches the other stations, it goes through the high-resistance winding, thereby generating in the low-resistance winding a current suitable for the 80-ohm ringer, *R*, in the local circuit.

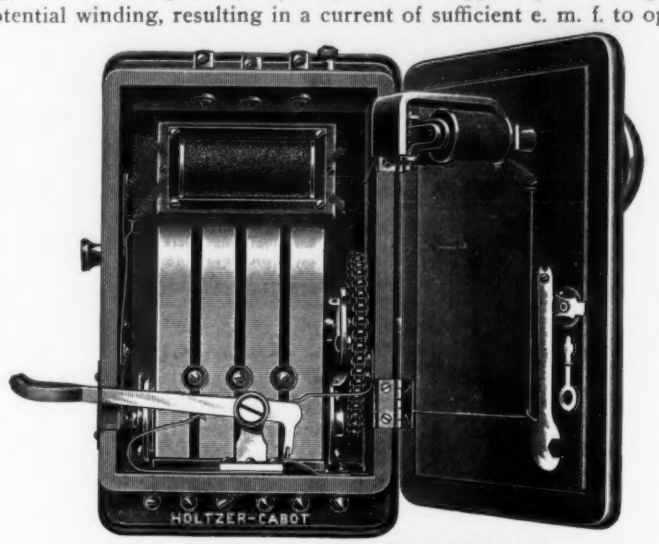


FIG. 3.—MAGNETO CALL-BOX WITH TRANSFORMER.

It will thus be seen that the transformer windings are reversible in inductive effect, the windings, *P* and *S*, being alternately primary and secondary, depending on whether a call is being sent or received. The generator, *G*, (Fig. 3), is provided with an automatic cut-in switch or push-button, as may be desired. The ringer, *R*, may be placed in series with the transformer and generator and in some cases this method in connection is desirable.

Among the advantages of this system is that it permits the ringer to be designed for the most favorable conditions with respect to sensitiveness and efficiency. That is, instead of the ordinary ringer having a resistance of not less than 1000 ohms, the resistance of the ringer in the inductive system can be fixed at any desirable value. The same remark applies to the design of the magneto. It is impossible to raise the voltage of the ordinary magneto telephone generator beyond certain limits in the machine itself without making the permanent field so large as to result in a machine excessively large and clumsy; and on the other hand, if the speed of the armature is increased beyond a certain value in order to increase the voltage, the bell hammer will not follow the alternations. By the use of the transformer the most efficient type of magneto may be designed and the voltage stepped up to any desired value.

FIG. 2.—TRANSFORMER.

Another advantage of the system is that the transformer which is connected across the line at each station, having a complete magnetic circuit, offers a much greater impedance to a telephone current than it is possible to obtain where the bells are connected directly across the line. The leakage through intermediate stations is thus reduced to a minimum when two persons are talking on the circuit.

A New Portable Photometer.

The accompanying illustrations show a new type of portable photometer which has recently been put on the market to fill a demand for a strictly portable form of photometer and one which at the same time will enable the various measurements to be made on incandescent lamps both rapidly and with accuracy not hitherto attainable in this class of apparatus.

One of the principal improvements in this instrument is the shielding of the eyes from the light emitted by both the test and standard lamp, while in the course of comparison. This is accomplished by surrounding the light at either end with a black curtain and using the bellows attached to the Bunsen carriage. In making accurate measurements this is found to be a very important point.

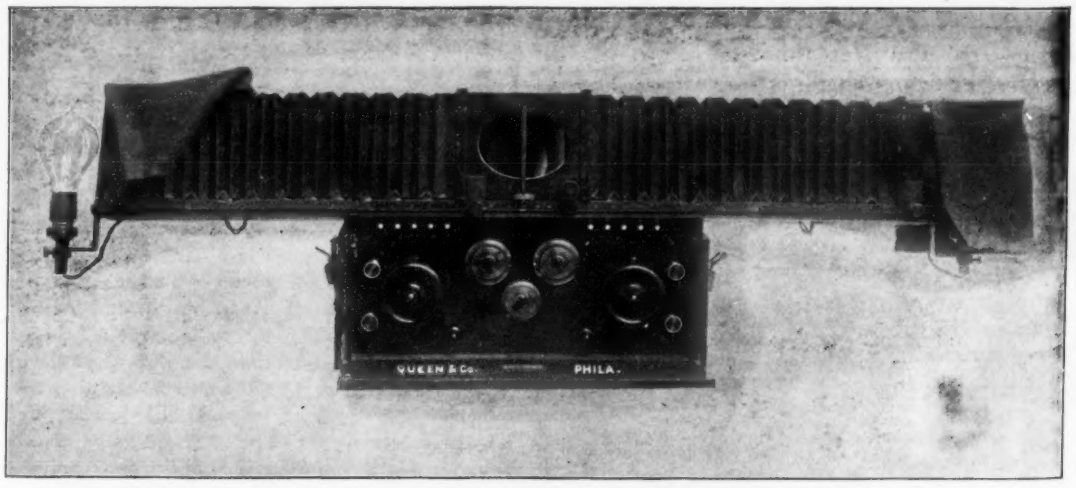


FIG. 1.—PHOTOMETER READY FOR USE.

The use of the oil lamp has been discarded, as its use necessitates chimneys, which are easily broken and oil which is constantly leaking in transportation. The incandescent lamp used as standard does away with these objectionable features and inasmuch as the standard and test lamp are both on the same circuit, changes of several per cent. in voltage affect the candle power of each lamp to such an equal extent that such fluctuations do not interfere at all with accurate comparisons. By means of a special switch the voltmeter employed can be thrown immediately from one lamp to the other without change of exterior connections and readings of voltage of each lamp can therefore be taken with one instrument. Suitable connections are also provided for the wattmeter and ammeter. Whenever it is desired to use the photometer without the wattmeter, a single switch enables this readily to be accomplished. An-

other switch operates in succession the standard and test lamps turning them off and on as desired. A rheostat is connected in series with each lamp so that the potential can be changed in order that lamps be balanced in candle power. The scale on the instrument reads direct in candle power. The dimensions of base are 5¾ in. x

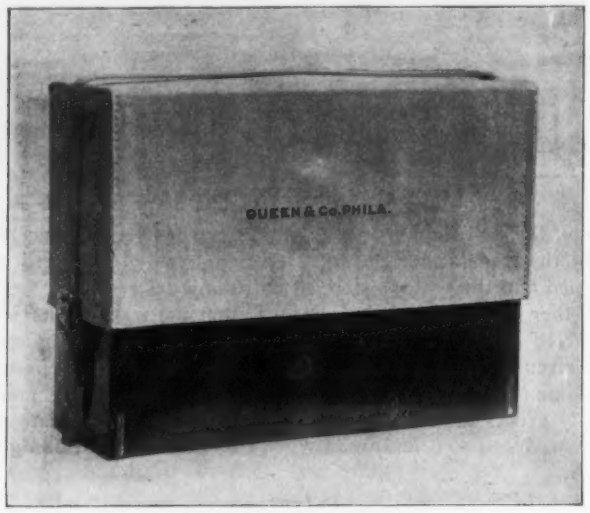


FIG. 2.—PHOTOMETER IN CASE.

16 in., thus enabling the instrument to be used on a small table or shelf.

The whole apparatus, although so compact and weighing but twelve pounds, may be set up in less than one-half minute, and lamps can be tested for both candle power at voltage, and voltage at candle power with current at each reading as rapidly as one per minute.

The instrument described has been put on the market by Queen & Company.

"Falcon" Electrical Specialties.

One of the most important fields of electrical development and improvement is that which embraces the detail devices, upon which, in the aggregate, an immense volume of business has been created, with every prospect of its indefinite expansion. Here is a field for invention, ingenuity and skill in manufacture as well as in the economy of material, that affords the best of oppo-tunities to progressive concerns, and toward which the energies of many of the leading spirits in electrical industries are being directed. Among the latest comers in this promising branch of electrical

FIG. 1.—ATTACHING PLUG.

FIG. 2.—FLUSH RECEPTACLE.

application is the Falcon Electric Manufacturing Company, of 432 East Seventy-first Street, New York City, who, starting but recently, have already begun to market their specialties in large quantites. We illustrate two of them herewith, one being their attaching plug and flush receptacle, and the other their radial amperemeter switch. The plug is fitted for the "Universal outlet box" and arranged for front connection, so that no slack wire need be left in the box. It can be completely installed and connected without the face plate, which is a preferable way to avoid damage to the plate by careless workmen around a new building. The face plate is furnished, as shown, with a lid for closing flush with floor or wall surface when the plug is withdrawn. The plugs are provided with fuse connections for both poles, and are interchangeable without diminution of the area or amount of metallic contact, the variation in the moulded porcelain being overcome by a stiff contact spring. The porcelain is of the best and is of high insulation.

The other device is intended to furnish means for bringing a number of circuits or feeder lines to one ammeter for readings, instead of having an instrument on each line. The switch here shown is so designed that one ammeter of the shunt type indicates the current readings of as many circuits as desired, in this case eight. It will be noted that the revolving arm carries within each set of contact clips a pin. This is so arranged with regard to the circle of holes at the center that the pin must infallibly fit the hole, for each reading at each step, so that the work is done very swiftly and surely. This switch has been adopted by the New York Electric Vehicle Transportation Company for its automobile charging plant at Fifty-third Street. These switches are furnished on wooden bases for re-mounting on switchboards.

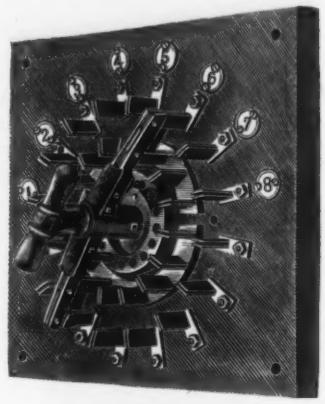


FIG. 3.—RADIAL SWITCH.

The Falcon Co. are now introducing their fan motor for 1900, a compact, handsome form with universal joints so that it can be adjusted and worked at any angle and in any position. This is, however, but one of the novelties they intend to put upon the market this season. They have very large factory facilities, with their own power plant, and have installed a costly equipment of the latest machine tools. The officers of the company are: E. Leissner, president; H. O. Swoboda, vice-president and general manager, and L. E. Frorup, secretary and treasurer. Mr. Swoboda is well known in electrical manufacturing circles, from his work as an inventor and his active connection with some of the most prominent concerns.

An Electric Light Gas Engine.

The accompanying illustration shows a new type of electric light gas engine, made by the J. W. Ruger Manufacturing Company, of Buffalo, N. Y. The engine is known as "The Fenner Improved," and was designed by J. B. Fenner, who is well known in the gas engine business, having made the gas engine his whole study for the past ten years.

The new engine is a single cylinder, horizontal, automatic cut-off graduated-charge engine, and is claimed to give as steady motion as any steam-electric engine, when either direct-connected or belted to a dynamo, and without a jack shaft or flywheel on the armature of the dynamo.

The engine is governed by an inertia flywheel governor of a new type, connected by a rod to an automatic cut-off. The graduated-charge valve is so constructed that it admits the proper proportions of gas and air, whether working on full load or part load, thus giving the charge the same richness at all times. The valve through the action of the governor responds instantly to any variation of the load. The charge is fired by a spark igniter, which is so constructed that it has a wiping motion with just enough contact to cause a spark at the proper time. The insulated electrode is so constructed that it can be removed instantly for cleaning, and can be reversed and replaced very quickly, while the small wear on it makes it practically indestructible. The sparker is driven by an eccentric keyed to the crank shaft of the engine, and makes but one turn while the shaft makes two turns, thus timing it perfectly and doing away with gearing or cams, which are both noisy and quickly worn out.

This eccentric also opens the exhaust valve at the proper time, holding it wide open just half of the time between the explosions and giving ample time for all the burned gases to be expelled. This leaves a clean cylinder for the next charge of pure gas and air, thus admitting of a powerful explosion since there are no burned gases to be mixed with the incoming charge. The engine takes a charge either light or heavy every second turn of the crank, as the load may require; there are no false charges or misses, consequently perfect regularity of speed is obtained. Every part of the engine requiring it is lubricated by automatic oilers, and all the bearings are so constructed that no oil is wasted or scattered around the engine.

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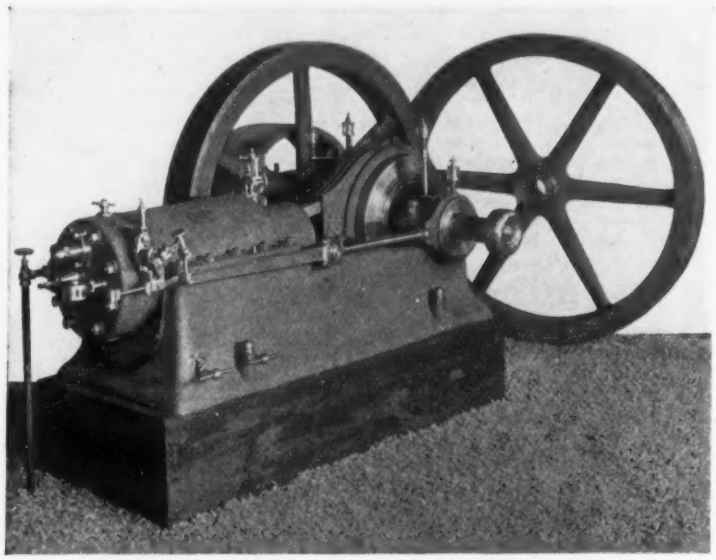
The construction of these engines is such that any one device can be removed without disturbing another, and there being few working parts and no cams or gearing, there is little chance of wear or derangement, and the engine is as noiseless as the best steam engines.

The crank shaft is made with balanced disks on the crank, and the engine is perfectly balanced so it makes no vibration. The exhaust is conveyed to an ingeniously constructed muffler near the



ELECTRIC LIGHT GAS ENGINE.

engine which deadens all sound, no noise being heard at the outer end of the exhaust pipe.

The illustration represents a 12-hp engine, which is made for either direct connection to dynamo or for belt-driven dynamos. All sizes larger than 12-hp are of the upright type with two or more cylinders and can be direct connected or belted to the dynamo. The manufacturers state that in a test of a 12-hp engine driving a full load with natural gas, the consumption of gas was from 10 to 12 feet of gas per hp-hour; and that on a test with illuminating gas of 18-cp, the consumption was 16 feet of gas per hp-hour.

Federal Battery Salt.

Sal ammoniac has held the field so long as a battery excitant for open circuit cells of various kinds that anything placed on the market as a substitute becomes at once an object of great interest to electricians. Federal Salt and Federalite, which is being vigorously pushed to replace sal ammoniac, and was referred to in some detail in these columns last week, has many advantages which are quickly recognized by large users of batteries all over the country. The fact that no crystals or creeping salts are formed is in itself an immense advantage. Few people stop to consider why their batteries are getting weaker and weaker, and fewer still lay the blame where it belongs.

When a solution of sal ammoniac is used the hard oxychloride crystals form on the carbon and zinc, clogging the pores and decreasing the actual working surface. The battery thus becomes less and less able to stand the work, which when new it was well able to accomplish; the recuperation thus becomes slower and the efficiency of the cell is greatly reduced. Federal Salt and Federalite form no crystals or creeping salts whatever under short circuit. In addition to this these salts contain an active soluble depolarizer, which enables the cell to recover its original strength in remarkably short time after being short circuited. The e. m. f. of a battery using Federal Salt or Federalite is higher than that of sal ammoniac and the current is practically constant during the life of the cell. This is due to the soluble zinc salts formed, which is a better conductor that the original solution, and to the higher heat units of the salts used. The Federal Battery Company, of 11 Pine Street, New York, who manufacture these salts, report a large and increasing demand for their goods and invite a thorough examination of their claims. They have many reports from large telephone and railroad companies which attest the facts given above, one of which is given herewith:

The report runs as follows: Our batteries were charged with Federal Salt on Feb. 1, and at time of test had been in use for seven months, and are still in service. There is no crystallization or creeping salts on the cells at time of test. The readings were taken when the telephone hook was off, reading every minute for five minutes. The hook was then returned, and the recuperation readings taken every minute also for five minutes. Test was made at the same time on new Leclanche cells charged with sal ammoniac and only used for these readings and have had no work. The readings of one telephone out of forty in service is given below, as well as the new sal ammoniac cell under the same test. Three cells were on the telephone in both tests.

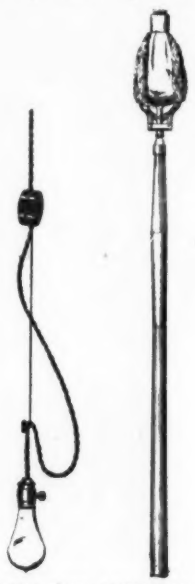
Federal Salt. Discharge.		Federal Salt. Recuperation.	
0 minute	4.30 volts.	5 minutes	4.25 volts.
1 "	4.20 "	4 "	4.25 "
2 "	4.15 "	3 "	4.25 "
3 "	4.05 "	2 "	4.22 "
4 "	3.95 "	1 "	4.20 "
5 "	3.90 "	0 "	3.90 "

Zincs eaten about one-third after seven months on telephone.

Sal Ammoniac. Discharge.		Sal Ammoniac. Recuperation.	
0 minute	4.24 volts.	5 minutes	3.55 volts.
1 "	3.10 "	4 "	3.43 "
2 "	2.40 "	3 "	3.20 "
3 "	2.10 "	2 "	2.91 "
4 "	1.95 "	1 "	2.62 "
5 "	1.90 "	0 "	1.90 "

The White Lamp Cord Adjuster and the Handy Bulb Cleaner.

The first of the accompanying illustrations represents the White lamp cord adjuster which is just being put upon the market by the Incandescent Electric Light Manipulator Company, 116 Bedford Street, Boston, Mass. This device is light in weight, takes up little space, is inexpensive and is recommended to do its work well. It is contained in an imitation rubber case, and is attractive and neat in appearance. The lamp can be raised or lowered by simply lifting it up or pulling it down to the required height. It can be easily attached to any lamp cord.



LAMP CORD ADJUSTER AND CLEANER.

The Handy lamp cleaner, shown in the second illustration, is manufactured by the same company. It is claimed to be the only device on the market that will clean the entire outside surface of the bulb of a lamp of any candle-power. It works automatically, and is three feet in length. It can be easily joined to a longer pole if necessary, in order to reach lamps in high places. It is stated that with the use of this cleaner a dozen lamps can be cleaned in the time it usually takes to clean one by hand, and, besides, the necessity of using a stool or stepladder to reach the lamps is avoided. These advantages are thoroughly appreciated by all who use these cleaners.

Specialty Manufacturing Company Fans.

The Specialty Manufacturing Company, Indianapolis, Ind., has placed on the market a water blow fan known as the "Junior," and shown in Fig. 1, to meet the demand for a good and serviceable type at low price. This fan has a ground tool steel shaft and a hard brass bush or bearing. The motor is enameled in black, and carries 13-inch blades of spring brass, nickel-plated, and protected with a wire guard. The motor is equipped with a jet 1-16 inch in diameter, thus insuring economical water consumption. The inlet or jet holder is provided with a thread which fits an ordinary ¼-inch hose coupling, enabling it to be easily and cheaply fitted with rubber hose for service and waste. The fan operates on any pres-

sure from 30 pounds upward, and weighs 9 pounds complete. Its weight boxed for export is 25 pounds.

The Triumph exhaust fan, also made by the same company, is illustrated in Fig. 2. This fan, which has been used extensively in the United States for a number of years, is made with a flat, square back, thus enabling it to be easily and cheaply placed in position. It is merely necessary to lag or bolt it up with the flat back to the opening, and it is ready for work. It is furnished with adjustable, self-oiling boxes, which are provided with genuine phosphor-bronze bushes.

These fans are accurately balanced and light-running. They are made for belt service only, and can be driven by any electric motor. These fans are particularly applicable for removing steam, odors

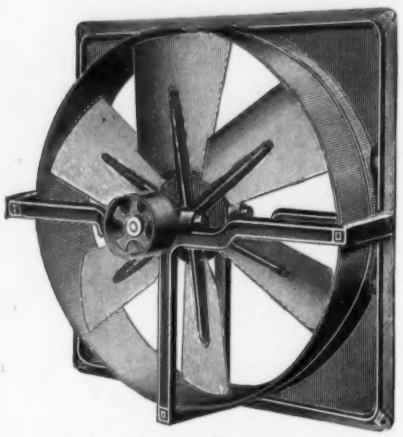


FIG. 1.—"JUNIOR" WATER BLOW FAN.

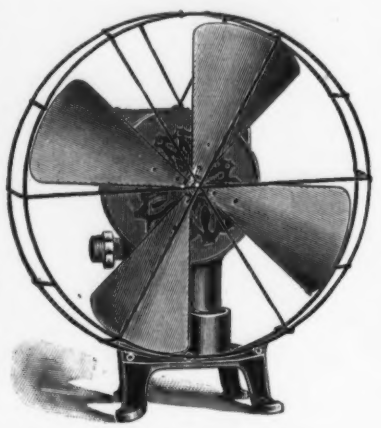


FIG. 2.—TRIUMPH EXHAUST FAN.

and heat from hotel and restaurant kitchens, steam laundries, dry kilns and rooms, woolen and cotton mills, engine and boiler rooms.

Hot Wire Ammeters and Voltmeters.

In a recent bulletin the Western Electric Company describes the S. K. C. system of hot-wire ammeters and voltmeters for which it is western agent. This type of instrument has for many years been manufactured by Hartmann & Braun, of Frankfort-on-Main, Germany, and the Stanley Company has secured the sole right to manufacture the instruments in the United States under the patents of the German firm.

Both the ammeters and voltmeters are entirely non-inductive, and the same instrument when standardized for use on direct currents is also strictly accurate for alternating currents and is not affected by frequency or forms of the wave. Moreover, they are not disturbed or affected by external magnetism or currents, or by changes of tempera-

FIGS. 1, 2 AND 3.—HOT WIRE AMMETERS AND VOLTMETERS.

ture in the surrounding air. They can always be kept in calibration by bringing the pointer to zero when no current is passing, an easily accessible screw being provided for this purpose. The switchboard instruments are accurate to within one-half of one per cent. and the portable type to within one-quarter of one per cent., throughout their useful range. The instruments are absolutely dead beat and therefore most desirable for direct-current railway work and for use in connection with synchronous motors and other classes of work where the current or e. m. f. is subject to frequent or constant fluctuations.

Only a small portion of the total current measured passes through the instrument, the main portion passing through a shunt of low resistance. For the switchboard type shown in Fig. 1, this shunt is external and can be used at any convenient point, the wires running from the shunt to the instrument being comparatively small. By providing several shunts the same instrument can be used for widely differing currents, in which case the instrument can be marked with several scales, or a table used for reducing the reading of a single scale to correspond with the other shunt connections. The portable instrument in shown in Figs. 2 and 3.

Bristol's Round Recording Pressure Gauge.

The illustrations herewith, Figs. 1 and 2, show exterior and interior views of a new round recording pressure gauge being placed on the market by the Bristol Company of Waterbury, Conn. This new form has been designed to meet the demand for a recording gauge at a lower price than the standard gauges of the same com-

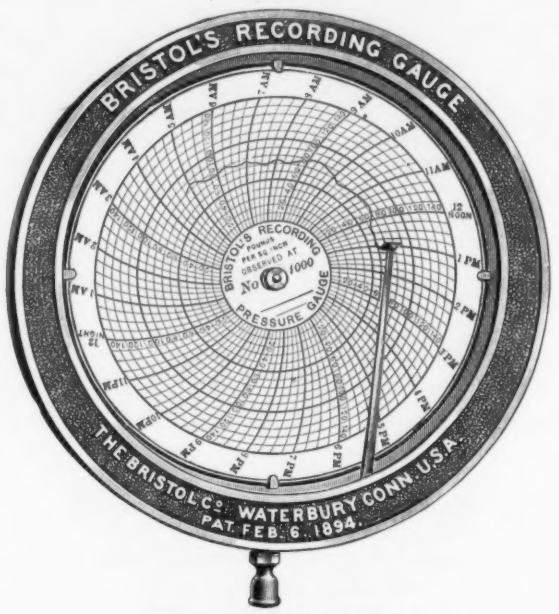


FIG. 1.—EXTERIOR VIEW.

pany. A special feature of the round form is that the dial is located slightly eccentrically to the main body of the case, thus allowing sufficient space on the lower side of the dial for the pen arm to pass out between the dial and the case.

Fig. 1 shows the exterior of the gauge complete and ready for ap-

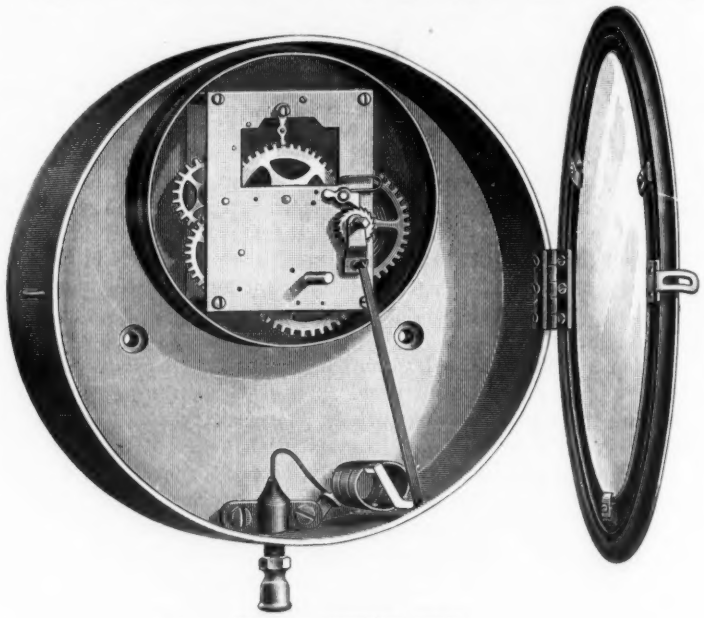


FIG. 2.—INTERIOR VIEW.

plication. Fig. 2 shows the interior construction of the instrument and the extreme simplicity upon which its accuracy and durability depend to a large degree. The pen arm is directly attached to the free end of a tube of flattened cross section which is bent into a helical form.

The tendency of the pressure applied is to straighten or uncoil the helical tube which causes the pen arm to move over the range of the chart without the necessity of any intervening multiplying devices.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET brought an eventful year to a close with the calm that succeeds a storm, but it was the calm of cheerfulness and restored fine weather, rather than that of mere exhaustion. It would indeed, looking back, be hard to give just all the reasons why the extreme nervousness of the month had prevailed so long and so intensely, but the rational explanation is still that there was a sympathetic action of our markets with those of England and that the cutting off of the supply of gold from the Transvaal coincided with a period when the volume of trade and speculation needed that gold most. But there will be easier money with the coming of the new year, and the January interest disbursements of perhaps $200,000,000 on leading securities will help matters considerably. Western Union closed the week at 85, a loss of ½. General Electric closed at 123¾, a loss of ¼. Brooklyn Rapid Transit was off ¼ to 72¼. Metropolitan Street Railway went to 175¾, and Manhattan Elevated was off 1¼ to 96½. In Chicago National Carbon preferred closed at 81; Chicago City Railway, 280; South Side Elevated, 100¾; West Chicago, 110½; Met. Elevated pref., 79¾. In Boston American Bell Telephone closed at 341 ex div.; Erie,, 99½; New England, 139½; Westinghouse, 39 com., 60 pref.; Mass. Elec. Rys. pref., 75; West End, 92¾; Boston Elevated, 98. In Philadelphia Elec. Storage Battery closed at 80-81 com., 85½ pref.; Penn. Elec. Veh. Co., 8⅝ com., 3⅝ pref.; Phila. Traction, 94¾-95; Union Traction, 38⅝.; Am. Rys., 5¼-5¾. In the New York outside market Elec. Axle Light and Power closed at 6-6¼; Elec. Boat, 24-28 com., 38-42 pref.; Elec. Vehicle, 70-74 com., 80-90 pref.; N. Y. Elec. Veh. Trans., 10⅛-11¼; New England, 5¼-5¾; Illinois, 2½-3. Some data as to ranges of the year is given editorially elsewhere.

LIABILITIES OF STEWART & CO.—Stanley H. G. Stewart, doing business as Stewart & Co., bankers and brokers at 40 Wall street, filed a petition in bankruptcy last week. The petition was sworn to by Mr. Stewart on December 28 in Washington, D. C. William H. Van Steenbergh is the attorney. The schedules give the liabilities as a firm at $282,111, and those of Mr. Stewart individually $41,859. The firm assets are nominally $1,213,857, and individual, $1,000. Mr. Stewart was formerly with Emerson, McMillan & Co., and in August, 1895, formed the firm of Stewart & Co., to trade in securities of railroads and manufacturing companies and to assist in reorganizing railroads. His son, Emerson M. G., was a partner up to June 9, 1898, since which time the petitioner has carried on the business alone under the firm style. Mr. Stewart became interested in a number of enterprises, among which were the Commercial Gas Company of New York and the Morley Acetylene Gas Company, of which concerns he was treasurer, and the St. Lawrence Power Company of Massena, N. Y. The firm assets consist of $390,900 stocks and bonds of the Commercial Gas Company, the Morley Acetylene Gas Company, and the Union Railway Company of Kansas City, Mo.; $650,000 claims for damages, of which $500,000 is against Charles A. Moreing and $150,000 against the St. Lawrence Construction Company; $170,615 debts due, the largest being $123,325 from the M. F. Armstrong and Crown Exploration Company of London; $1,160 notes, $1,000 office furniture and $181 cash in the Colonial Trust Company. Of the liabilities, $241,477 are secured by stocks and bonds valued at $751,300 of the following companies: St. Lawrence Power Company, American Impulse Wheel Company, N. E. Gas and Coke Company, Sedalia Electric Railway Company, and Sedalia Electric and Heating Company. Among the secured creditors are the Colonial Trust Company, $105,000; Hanover National Bank, $66,202; Albert H. Prentiss of Buffalo, $11,250; American District Steam Company of Lockport, N. Y., $37,789, and the General Electric Company $8,855. The unsecured liabilities are $37,130; wages, $230, and accommodation paper, $3,150. Mr. Stewart was not a member of the Stock Exchange.

GENERAL CARRIAGE.—A violent collapse has taken place in the market price for the stock of the General Carriage Company, a New York concern which owns a charter granting wide powers. Some of those interested in the company are also interested in various air-power enterprises. They say that under its charter the company has the right to run stage lines in any street of any city of the first class in this State. Any attempt, however, to establish such lines, it was stated, would result in immediate litigation. Three weeks ago the price of the stock was bid up in the curb market from $50 a share to $200 a share, with scarcely a transaction. The advance was ascribed to the existence of a short interest, with no floating supply of stock for the shorts to borrow to make deliveries with. Since then the market for the stock has broken. On Thursday last week 100 shares were offered for sale at $45, and no buyer at this price could be found. On Friday the stock was offered at $10 a share, and the best bid was $1. One lot of 100 shares sold Saturday at $5 a share, and later the ruling quotations were $3 bid, $5 asked. The recent bulge is explained by the statement that all the stock of the company excepting a few stray odd lots was pooled some time ago, so that it could not be sold. The pooling arrangement, it was reported yesterday, expired January 1.

INDUSTRIAL IMPROVEMENT COMPANY.—The directors of the Industrial Improvement Company have declared a dividend in liquidation of $30 per share, payable January 1, 1900. The company has previously paid $80 per share, making in all $110 a share thus far distributed. A further small dividend of probably $2 or $3 will be paid in final liquidation. The Industrial Improvement Company was organized in 1890 in Boston by Mr. Alfred A. Glasier, who was its first treasurer. The capital of the company is $1,000,000, $750,000 cash having been paid in. The stockholders have received from time to time rights to purchase shares of various street railway stock owned by the company at advantageous prices, which rights have netted to those who held the stocks over $63 a share on the stock of the Industrial Improvement Company. This $63, together with the dividend declared and what is reasonably expected will be paid in the future, will realize to the stockholders about $175 a share, at an original cost of $75 per share. The street railway properties built by this company were the Brockton Street Railway system, the Lowell, Lawrence and Haverhill Street Railway system, and the Allentown and Bethlehem Rapid Transit Company of Pennsylvania.

DIVIDENDS.—The Erie Telegraph and Telephone Company has declared regular quarterly dividend No. 65 of 1¼ per cent.; Wisconsin Telephone Company dividend No. 70 of 1¾ per cent., and the Michigan Telephone dividend No. 62 of 1¼ per cent. The directors of the Erie telephone system have fixed permanent dates for future payments of quarterly dividends, namely: The second Monday of January, April, July and October, to stockholders of record at the close of business on the last day of December, March, June and September. It is said that the directors of American Steel and Wire will meet in Chicago January 29 and declare a dividend on the common stock of 6 per cent for the year 1899. Future dividends, it is said, for 1900 will be paid quarterly at that rate. Information which is believed to be trustworthy is that the Chicago Metropolitan Elevated Company will declare a flat dividend of 2 per cent. January 4 and a quarterly dividend of 1 per cent., both payable in March, 1900. There is excellent authority for the assertion that the net earnings of the system for the last six months would practically give 2 per cent. to the stock.

NEW YORK LIGHTING SECURITIES.—The New York Gas and Electric Light, Heat and Power Company has listed upon the Stock Exchange $11,500,000 of its first mortgage bonds and $20,191,000 of its purchase money mortgage bonds. The purchase money bonds are each for $1000, maturing February 1, 1949, bearing interest at 4 per cent. in gold coin. Of the proceeds of this issue $20,240,000 are to be applied in acquiring the shares of the capital stock of the Edison Electric Illuminating Company of New York. The total capital stock of this company is $9,200,000 and the purchase price is 220 per cent. of the par value of said stock. About 89,000 out of the 92,000 shares of the capital stock of the Edison Company has been acquired at this date. The first mortgage bonds bear interest at the rate of 5 per cent. in gold coin, and mature December 1, 1948. Proceeds of the issue were applied as follows: $7,500,000 on account of the purchase price of the constituent companies and $4,000,000 to create a cash guarantee fund, which may only be invested in extensions or betterments. At the beginning of this week, some very circumstantial reports were current that the Consolidated Gas Co., or the Rockefeller interests in it, had bought control of the company, and having control already of the United Electric Co., thus monopolize central station work in New York City.

CHICAGO ELEVATED REFUNDING SCHEME.—At the Northwestern Elevated Railroad Company's office it was stated last week that the $5,000,000 5 per cent. forty-year gold bonds would be issued at a special meeting of the stockholders to be held before the new year. The meeting was simply a legal form which it is necessary to observe. The bonds are to be issued to take the place of those issued under the mortgage of August, 1884, which are pledged now to secure the $4,500,000 loan made by the Blair syndicate. The proceeds of the new issue will pay off the Blair loan, thus releasing the share capitalization of the Northwestern Elevated and make it available for distribution to stockholders of the Columbia Construction Company. Construction of the road has been pushed during the past thirty days, and trains will be running this week to save its franchise.

CHICAGO TELEPHONE COMPANY.—The annual meeting of the Chicago Telephone Company will be held January 17. At that

time the directors will recommend to the stockholders a proposition to increase the authorized issue from $5,000,000 now outstanding to $15,000,000. If this proposition is carried shares of the increased capital will be offered to stockholders at par in proportion to their holdings.

CHICAGO EDISON.—An issue of $1,000,000 new stock will be made on February 1 by the Chicago Edison Company. Stockholders of record January 25 can secure the stock at par. Each holder can subscribe for 20 per cent. of his ownings. The growth of the Edison business like that in New York is very rapid and requires at least a million new capital every year for new plant and extensions of the system.

A BANKRUPT MUNICIPALITY.—The city council of Austin, Tex., has voted not to pay interest on its $1,327,000 5 per cent. city water and light bonds due January 1, 1900. The city is thus forced to default in the payment of its quarterly interest. This measure is understood to mean that the council intends repudiating the issue. Some few years ago the municipality invested heavily in an electric light and power plant of its own, but has been unable to make it pay.

CONNECTICUT TROLLEY BONDS.—The directors of the People's Tramway Company of Killingly have authorized an issue of $600,000 thirty-year 5 per cent. first mortgage bonds, of which $200,000 are to be put out by the Colonial Trust Company of Waterbury. Later reports go to confirm the acquirement of control of the property by the New Haven Railroad Company.

Commercial Intelligence.

THE WEEK IN TRADE has been quiet, owing to the holidays, but necessarily busy on account of the close of the year. Prices all along the line have been if anything steadier and almost all lines of production report a good demand. The intensely cold weather has come just in time to give the required stimulus to the trades that depend on it for the consumption of goods made up in advance, while again the spring trade beckons very hopefully. Foreign trade for the year rounds up splendidly, exports reaching just about $1,280,000,000, or nearly 3 per cent. more than in 1898, when agricultural exports were so heavy. The gain has been largely in manufactures, and the excess over imports is again over $400,000,000 to our credit. The proportion of manufactured goods in exports has now reached one-third of the total. Of these goods, electrical and the apparatus in the same class constitute a large and growing proportion, which is not likely to suffer from the display at Paris this year. As to the week itself, Bradstreet's notes that bank clearings show a shrinkage from the enormous total of the preceding week, which holds the weekly record for the year, aggregating $1,595,375,229, a decrease of 28 per cent. from last week, but a gain of 13 per cent. over this week a year ago, of 34 per cent. over 1897, of 56 per cent. over 1895, of 69 per cent. over 1894, and of 50 per cent. over the corresponding week of 1892. Bank clearings for the year will, of course, break all records in a total of $93,300,000,000, 36 per cent. heavier than last year and correspondingly larger than in any previous year on record. Business failures for the week number 220, as compared with 211 last week, 218 in this week a year ago, 297 in 1897, 329 in 1896 and 316 in 1895. For the year failures are the smallest in number for seventeen years past, and, were it not for a few heavy financial suspensions in December, liabilities, which will exceed those of 1892 slightly, would have been the smallest for twelve years past. Dun's says that the increase in demand for iron and steel products is the great feature of the year. The industry is now producing about 300,000 tons weekly, and unsold stocks are reduced to 122,923 tons, and yet orders unfilled will require six to nine months' work from most of the establishments. Prices have not changed the past week, though demand for some products improved a little. The average of prices closes 119.5 per cent. higher than January 1 for pig and 102.8 per cent. higher for products.

EXPORTS OF ELECTRICAL MATERIAL FROM NEW YORK.—The following were the exports of electrical material and kindred lines from the port of New York for the week ended December 23: Argentine Republic—283 cases electrical material, $36,628; 5 cases electros, $29; 87 cases electrical machinery, $5131. Alexandria—7 cases electrical material, $315. Brussels—12 cases electrical material, $1020. British Australia—1 case electrical material, $90. British East Indies—4 cases electrical material, $242; 3 cases electrical machinery, $130. Berlin—1 case electrical machinery, $28. British West Indies—63 packages electrical material, $456. Barcelona—66 cases electrical material, $11,276. Central America—21 cases electrical material, $437. Chili—14 cases electrical material, $806. Cuba—1 electric light plant, $3964. Ecuador—19 cases electrical material, $250. Glasgow—1 case electrical machinery, $4750. Hong Kong—11 cases electrical material, $300. Havre—1 case electrical machinery, $83. Hamburg—57 cases electrical machinery, $1100. Japan—32 cases electrical material, $2104. Leicester, 3 cases electrical material, $132. Marseilles—258 packages electrical material, $8520. Manchester—216 cases electrical material, $4343. Nova Scotia—1 case electrical material, $37. Naples—42 cases electrical material, $14,452. Newfoundland—10 cases electrical material, $313. Peru—67 cases electrical material, $2154. Southampton—5 cases electrical material, $100. St. Petersburg—3 cases electrical material, $157. Turin—9 cases electrical material, $1294. For the week ending December 30 the exports were: Antwerp—41 cases electrical machinery, $3949. Argentine Republic—36 cases electrical machinery, $1539; 749 cases electrical material, $39,676. British Australia—20 cases electrical material, $1052. Brussels—3 cases electrical machinery, $135. British West Indies—73 cases electrical material, $1310; 73 cases electrical material, $210. Brazil—138 cases electrical material, $5918; 18 cases electrical machinery, $1273. British Possessions in Africa—3 cases electrical machinery, $52; 3 cases electrical material, $99. Central America—22 cases electrical material, $983. Dutch Guiana—1 case electrical material, $405. Danish West Indies—1 case electrical material, $16. Hamburg—61 cases electrical material, $6001; 54 cases electrical machinery, $1450. Havre—53 cases electrical material, $3985; 100 cases electrical machinery, $2000. Liverpool—5 cases electrical material, $200. Mexico—63 cases electrical material, $2365; 8 cases electrical machinery, $43. Newfoundland—27 cases electrical material, $179. Nova Scotia—1 case electrical material, $15. Odessa—11 cases electric motors, $1150. St. Petersburg—79 cases electrical material, $6989.

EXPORTS TO RUSSIA.—American goods, and especially American manufactures, are making rapid gains in popularity in Russia. This fact is shown not only by the increased total of our exports to that country, but by the warnings which the consular representatives of other nations in Russia are sending to their home governments respecting the popularity of American goods and the success of American merchants in their business methods. British consuls in Russia have recently sent to their government a series of statements upon this subject, copies of which have just been received by the Treaury Bureau of Statistics. The British consul at Kieff in his report says: "While Germany is talked about as our greatest rival in the markets of the world, there does not seem to be the same attention paid to the rapidly developing competition of America. The strides America is making are startlingly apparent in the foreign trade. The agricultural machinery trade is practically controlled by America, the trade in duplex and other steam pumps is more or less American, the introduction of improved machine tools is due to America, which is now reaping the benefit of practical ideas combined with utility, and now the supply of fixed steam engines to the foreign markets is being energetically pushed." The exports to Russia from the United States were ten million dollars in the year 1898-99.

TRADE CONDITIONS IN FORMOSA.—In an article contributed to the "New York Tribune," Mr. W. J. Johnston refers to the very unfavorable trade conditions which have existed in Formosa since that island came into the possession of the Japanese. In the attempt of Japan to colonize the island it antagonized not only the native and Chinese population, but also the British, German and other traders on the island. The camphor trade has been ruined for these and everybody concerned, and the natives, Chinese, foreign traders and even the Japanese themselves are, he says, thoroughly weary of the whole business. Owing to the changes inaugurated, the natives have the greatest hatred toward the Japanese, which has led to a condition causing rebellion and brigandage to flourish under the very nose of the authorities, who seem to be impotent to establish or maintain order. Formerly the Chinese maintained a kind of working arrangement with the natives which permitted the carrying on of trade, but under the Japanese the natives will submit to no restraint. As among other savage branches of the Malay race, the possession of a head by a Formosan young man is necessary before he can take rank among men or become married, and under the present conditions head hunting proceeds apace, the Japanese securing themselves by confinement to fortified places.

THE BRASS CONSOLIDATION.—The final organization has been perfected in the brass combination. The American Brass Company has been launched, with a capitalization of $6,000,000. It has now absorbed the Coe Brass Company, of Torrington; the Ansonia Brass & Copper Company and Wallace & Sons, of Ansonia, the last named for some time being controlled by the Coe Company. The Scoville Manufacturing Company, Holmes, Booth & Hayden, Benedct & Burnham and the Plume & Atwood Company are not to be affiliated, and the stock originally subscribed by these has been surrendered. All the stock is controlled by the present owners and their friends, and will not be placed on the market. Charles F. Brooker is the president. The other officers are: First vice-president, Alfred A. Cowles; second vice-president, James S. Elton; secretary and treasurer, John P. Elton. Directors: C. F. Brooker, J. S. Elton, A. A. Cowles, J. P. Elton, James A. Doughty, Elisha Turner, Chandler N. Wayland, William E. Dodge and D. Willis James. The executive committee consists of C. F. Brooker, J. P. Elton, James A. Doughty and A. A. Cowles.

INDEPENDENT TELEPHONE MANUFACTURE.—Very circumstantial stories cropped up again in the daily newspapers as to the combination of independent telephone manufacturers, and a list of names was given, as usual, Chicago concerns being specially named. At first it was said that the meeting was to be held in New York early this week, which would imply, as before, dependence on Eastern capital for successfully carrying out the plan. We happen to know of work now being done to execute some such plan, but details will remain vague for some little time, although possibly something may occur by Thursday of this week. Several of the manufacturers seen say they are not in it at all; others are very circumspect of speech, and others who have tried to get at close quarters with the negotiating parties seem rather disappointed over the inability to get them "out of the air." Although capital is looking askance just now at new industrial consolidations, it is urged that the new strength of the independent telephone movement justifies this revival of last year's plans.

COPPER PRICES.—Vice-President Wm. H. Baker of the Postal Telegraph Company says regarding the price of copper at 16½ cents and its industrial effect: "Our company has reached the conclusion that aluminum wire is preferable. The wire must be twice as large to obtain the same conductivity, but in spite of its increased size it is much lighter than copper, and already cheaper. If the present price of copper holds, aluminum will be generally adopted by all concerns which require wire to transmit electricity. If the light metal comes it will come to stay." A despatch of December 27 from Berlin says: "An official of the Allgemeine Electricitaets Gesellschaft, which is the largest in Europe, discussing the fall in copper prices, said to-day: "So far as Germany is concerned, there is no occasion for a fall in price, since copper consumption here is still increasing and the condition of the electrical industry points to an increased consumption. I must admit, however, that aluminum is coming into sharp competition with copper for trolley wire."

ELECTRICAL FREIGHT CLASSIFICATION.—The National Electric Light Association has just issued, with special motive, a pamphlet containing the report of its committee on amendments to freight classifications of electrical apparatus and goods. As is well known, a mere casting is advanced from fourth class to first class if the word electrical happens to get in front of it, and thus from New York to San Francisco will cost $3 a hundred instead of 90 cents. In the same way cut-glass lamp shades can be shipped first class in small lots if they are not called "electric." These absurdities and inconsistencies inflict a heavy tax on the electrical manufacturer and his customers, and now that there is a classification agitation on, there may be a better chance than usual to get the evil corrected. The Association committee consists of Messrs. James I. Ayer (past president), chairman; G. W. Davenport and W. C. Bryant.

MATERIAL FOR CUBA.—The Cuban Electric Company formed for operating a ferry line between Havana and Regla have also acquired the steam tramway between Regla and Guanabacoa, a distance of four miles, and are converting it into an electric railroad in connection with the ferry line. The rails, supplied by the Pennsylvania Steel Company, have just been laid and the foundations are ready for the erection of the new power station, which is being furnished by the Riter-Conley Manufacturing Company of Pittsburg. The equipment, shipped recently from Philadelphia to Havana for the company, includes two 500-hp generators from the Westinghouse Electric and Manufacturing Company; Cahall water tube boilers, 1000-hp, from Thayer & Co., Limited; six trolley cars complete, from the J. G. Brill Company, and 300 iron trolley poles, from the Electric Supply & Equipment Company of Cincinnati.

FOREIGN TELEPHONE SHIPMENTS.—The Connecticut Telephone & Electric Company, of Meriden, Conn., manufacturers of telephones and telephone equipment, etc., made shipments last week of their apparatus to Canada, Jamaica, West Indies, Cuba, New Zealand and Chili, the batch for the last named country weighing six tons. In fact, their foreign business has increased very rapidly within the last few months, and in general has grown to such an extent that they are now doubling their productive capacity so that by the middle of January they will be able to take care promptly of all orders received. Under competitive test their telephonic material has stood up handsomely, and one independent exchange has just doubled its original equipment from them. A larger demand than was expected is reported in particular for the type C desk set recently placed on the market.

DRIVER-HARRIS WIRE COMPANY.—The firms of Wilbur B. Driver of New York and F. R. Harris of Waterbury, Conn., have been consolidated under the name of the Driver-Harris Wire Company. The business of the two concerns will be carried on as heretofore with increased facilities. The company's attention will be devoted particularly to the manufacture of resistance wires and fine wires in all metals, ranging from No. 15 B & S (.057) to .001". They are prepared to furnish brass, copper, phosphor bronze, German silver, iron, steel and any other material that can be drawn. All outstanding accounts will be settled with Driver-Harris Wire Co.

BULLOCK ISOLATED PLANTS.—Mr. R. T. Lozier, since his return from England, has been looking up a lot of domestic business in this vicinity for the Bullock Electric Manufacturing Company, which he represents, and in connection with the Payne Engineering Company of 120 Liberty street, will install an isolated Bullock plant directly connected to three Payne high speed engines in the Battery Park Building, and another plant of two generators with two Payne engines in the Broadway Chambers. The Payne Company, by the way, have opened a London office at 39 Victoria Street, in charge of Mr. W. H. Merriman.

SPECIALTY MANUFACTURING COMPANY, of Indianapolis, through their secretary and treasurer, Mr. J. B. Dill, inform us that they have received from Moscow, Russia, a direct order for the immediate shipment of twelve Triumph exhaust fans in assorted sizes from 30 to 42 inches. This order is the more gratifying, as it comes after a thorough trial of the apparatus, a sample order having been shipped to the customer last February. The Specialty Company are pushing for trade in all parts of the globe, and furnish another proof of the welcome that awaits American mechanical productions.

BOILERS WANTED.—Sealed proposals will be received by the Board of Public Works of Holland, Mich., at the office of the clerk, until 7:00 o'clock p. m., of Monday, January 15, 1900, for the furnishing of a boiler for the Holland City water works and electric light plant. The boiler must be of at least 250-hp capacity, with stack and necessary and usual appurtenances, and able to carry 150 pounds working steam pressure. Each proposal must be accompanied by full specifications of what the bidder will furnish and by a certified check of $300, payable to Arend Visscher, president of the Board of Public Works.

MATERIAL FOR GREAT BRITAIN.—The corporation of Glasgow has accepted the tender of the National Conduit & Cable Company of New York City for supplying the feeder cables necessary for the extension of the city electric railway system. The value of the contract is £151,000 ($755,000), the American company getting the order at a price £10,000 ($50,000) below the lowest British bid. A cable despatch from London states that the County Council is going in for electric traction on American methods and will probably soon be in the market for large quantities of material.

ENLARGING POWER PLANT.—The Oswegatchie Light and Power Company, of Gouverneur, N. Y., contemplate enlarging their plant to twice its present capacity. The company name is derived from the river flowing near Gouverneur, and the transmission is about three miles. The existing electrical equipment includes one three phase machine of 120-kw 60 cycles, at 2280 volts, and one 50-arc light machine, both of General Electric construction, and one American Wood 50-arc lighter. Mr. C. E. Leach is the electrician of the company.

TOERRING ARC LAMPS ABROAD.—The C. J. Toerring Company, of Philadelphia, report that they have recently made the following foreign shipments of their arc lamps: Italy, Austria, Germany, Puerto Rico and South Africa. Domestic shipments as follows: Bridgeport, Conn.; Chicago, Salt Lake City, and 216 lamps to Baltimore. They have added to their already long list of agencies the following: Mr. C. M. Wheelock, Wilmington, Del., and Mr. Charles W Kent, Oswego, N. Y.

CABLE FOR PHILIPPINES.—The W. R. Brixey Kerite Cable Co. made its last shipment on December 21 of an order from the government for 100 miles of signal wire of No. 14 gauge, covered with braiding and kerite. This wire is to be used in the signal service operations in the Philippine Islands, and is consigned to Manila. The order was received with instructions to rush, and the factory worked 13 hours a day to get it out in order to catch a transport sailing for the Philippines.

FAN MOTOR COMBINATION.—The organizers of the plan to advance fan motor prices had another meeting last week in New York City at the Hotel Imperial, but so far as can be gathered final action is still to be taken, although there is unanimity as to the desirability of a good advance properly sustained. The same is true of the recent movement for maintaining prices on dynamos and motors, to which it is hoped to give full effectiveness this year.

THE PENNSYLVANIA MACHINERY COMPANY have taken an order for a complete plant for Christ & Co.'s building, Spring Street, Philadelphia, to operate machinery on seven floors by motor, power being supplied by a 60-hp engine in the basement of the building.

ROSWELL WATER POWER ELECTRIC COMPANY, a new corporation, wants prices and descriptive circulars on the best and cheapest underground wiring system for light and power, also on alternators, etc. Address all matters registered to George F Blashek, Roswell, Chaves County, New Mexico.

Special Correspondence.

NEW YORK NOTES.

New York, Jan. 3, 1900.

DURLAND'S NEW RIDING ACADEMY, on Sixty-sixth Street, will have a tanbark ring 200 by 100 feet, and will be able to accommodate 2500 spectators. It will be lit by electricity and will have electric elevators, ventilators, etc.

B. R. T.—The New York grand jury has been dismissed. It found no indictment in case of B. R. T., but asked the court to have the next grand jury continue the investigation, as to the alleged criminal attempts to depreciate the value of the stock and wreck the company.

TRIAL OF A NEW CAR FENDER.—The Third Avenue Railway Company is testing a life-saving fender. It is arranged to fold up compactly when not in use, and it is fitted with a bracket on each side, which prevents objects caught in it from falling out. On a level road, it does not run more than an inch above the track.

BROOKLYN TRAVEL COMPLAINTS.—The state board of railroad commissioners with regard to the complaints against the Brooklyn Heights Railroad reports that the company engaged in the "herculean task" of operating 504 miles of street railway is doing as much as possible for its patrons. The only change recommended is that of optional transfers.

CABLE EXTENSION.—The Western Union Telegraph Company announces that the cable recently completed from Cape Town, South Africa, to the island of St. Helena has been extended to Ascension Island. Messages are now accepted for Ascension Island at the rate of $1.71 a word beyond London. It is expected that the cable will be extended north, forming another route to South Africa. It probably is to be completed about the end of March, 1900.

MR. H. H. VREELAND, in an article in the New York *Times*, says: "In 1872, according to the official figures, the whole number of people transported by railways of all kinds within the city limits was 138,889,439; that in 1882 the number had grown to 250,510,832; that in 1892 it had further increased to 448,947,981, and that conservative estimates justify the belief that in 1902 it will exceed 600,000,000." On his metropolitan system there are 4000 to 5000 men employed, and he describes the plans adopted for their improvement and benefit.

MR. ROYAL E. BALL has issued a notification to the electrical community that he has transferred his interests in the Ball system to the Ball Electric Company, of New York, and that he will remain in the service of that company. Under new auspices, with a fine plant and a progressive business management, the company is going to make a strong bid for patronage in the electric light and power field, and has made its factory and headquarters at 404 West Twenty-seventh Street. It will be glad to receive inquiries for dynamos, etc., and to quote prices on a large range of sizes and outputs.

DAMAGE BY FIRE.—A bad fire broke out on the night of December 29 in the wall paper factory of William Campbell & Co., at the foot of East Twenty-fourth street. The firm is a big one and has been very unlucky in this matter of fires. The Manhattan Electric Light Company, occupying the lower part of the building, were burnt out also, with considerable loss, although insured, and a large area of streets was left in darkness on the east side, until the next night, when the lamps were fed from other sources of current. A wall of the burned building fell on the cable manufacturing plant of the Bishop Gutta Percha Company and completely ruined the valuable machinery. It will require six months to get a new plant in full running order, when the company will have increased its facilities 50 per cent.

AN ELECTRIC EVIL EYE.—Piled up on a table in United States Commissioner Shields' office are 26 sets of papers, which by the binding and make-up appear to be legal in their character, but which are really the productions of a man, alleged to be a crank, who for over a year has daily disturbed the judges and officials in the Federal Building. He describes himself as E. D. Thompson, a native of Waldron, Ind., and a graduate of a college in Cincinnati. The man, who gives his residence in this city as at 136 Lexington Avenue, imagines that Dr. Spitzka and others, including George J. Gould, have an electrical influence over him, and he is continually petitioning the United States Circuit Court to grant a restraining order which will free him from the mysterious electrical power.

KINGSBRIDGE FRANCHISES VOTED.—Both branches of the municipal assembly voted on Dec. 30 to grant the Kingsbridge & Eleventh Avenue Railroad franchises to the Third Avenue and Metropolitan Railroad street franchises under the terms fixed by the board of Estimate and Apportionment. These franchises will run for 25 years. The companies must pay 4 per cent. of the gross receipts for the first five years, 6 per cent. for the next five, 8 per cent. for the next five, and 10 per cent. for the last 10 years. Councilman Brice, in advocating the passage of the franchise in the council, said that it was his belief that the development of the upper part of Manhattan Island, which would result from the running of street cars up there would pay the city liberally for the rights which it confers on the street railway companies.

NEW INDEPENDENT TELEPHONE COMPANY.—The American Independent Telephone Company has been organized in this city to take the place of the Telephone, Telegraph & Cable Company of America. It is said that the latter organization met with some reverses in the last slump in the market, with the result that several of the financiers connected with it, whose financial support was of utmost importance, were compelled to sever their connection with it. The Drexels, of Philadelphia, and the banking house of J. P. Morgan & Co., of this city, it is stated, are interested in the new company. So strong are the interests of these two houses that their personal representative, in the person of Edward Troth, of Philadelphia, will become the president of the American Telephone Company. The formation of this new company, it is asserted, brings an important factor into the independent telephone situation. It will be remembered that the Telephone, Telegraph & Cable Company of America announced a short time ago that a pool had been completed with the Knickerbocker Telephone & Telegraph Company and the People's Telephone Corporation. The latter two companies were to be consolidated and operated as a local company of the National Company. It is now said that the People's Company will ally itself with the American Independent Telephone Company, as there are interests in each company which are strongly identified in other enterprises.

NEW ENGLAND NOTES.

Boston, Mass., Dec. 30, 1899.

A BIG SWITCHBOARD.—The last shipment of the switchboard for the Union Traction Company, of Philadelphia, has just been made by Albert & J. M. Anderson, of Boston, Mass. The installation is made by Mayer & Englund. The switchboard consists of 58 panels, and is one of the largest in this country.

MR. J. E. WILSON, the popular and well known salesman, for eight years connected with the Pettingell-Andrews Company, of Boston, resigned his position recently with that concern. Mr. Wilson is now with the C. S. Knowles Company, and covers the same territory he has worked in for the past eight years.

AUTOMOBILE LINE.—Mayor Quincy has appproved the order passed by the board of aldermen granting locations for an automobile merchandise and passenger traffic line to the Boston Transit Co., Henry B. Hyde, president. The routes include streets leading from the North Union Station and Adams Square to and through the Back Bay, over Beacon Street, through Commonwealth Avenue and to Franklin Park, and return by nearly the same route. The omnibus that has been considered seats 20 or 22 persons, four or six of them outside. The vehicles will probably be built in Hartford, Conn. Electricity will be their motive power, according to the statements of the promoters, though the Boston Transit Company is authorized to use compressed air, gasolene, or anything else. It is authorized also to carry freight and parcels and even mails, though nothing has been done about providing facilities for any such business in the vehicles so far considered.

PENNSYLVANIA AND OHIO NOTES.

Philadelphia, Pa., Dec. 30, 1899.

MR. BOLLING H. HARRISON, of Baltimore, has been appointed manager of the Philadelphia office of the C & C Electric Company at 45 North Seventh Street, succeeding William Myers, who is no longer in any way connected with the company. Mr. Harrison is a graduate of Lehigh University, and for several years has been engaged in engineering and construction work with Mr. J. C. M. Lucas, of Baltimore. He is well known and much liked in the Philadelphia and Baltimore territory. After Jan. 5 Mr. Harrison will be in charge of the C & C Philadelphia office, and hopes for a continuance of the liberal patronage which has heretofore been accorded the company.

THE FUTURE OF AUTOMOBILES.—At a meeting of the electrical section of the Franklin Institute, held Dec. 22, several well-known electrical engineers spoke on the future of automobiles. Mr. Pedro Salom prophesied that the automobile of the future would be a cheap and light electrical vehicle. He admitted the batteries were heavy, requiring strong construction in the carriage, and that the cost of pneumatic tires and their maintenance was a serious consideration. He asserted, however that these difficulties were being surmounted, that lighter batteries would be made, and that the tire question was being solved. Mr. Rudolph M. Hunter said that the electric vehicle had a very limited field of usefulness. The weight of the battery, he thought, could not be reduced much and yet retain its efficiency. He predicted that in the next ten years gasolene motors would be used on heavy express and freight wagons. Mr. Henry G. Morris described experiments made in Chicago in deep snow, which he declared could not have been duplicated with horses. Automobiles, he asserted, should be built to meet present street conditions. Prof. William D. Marks said that in France the electric automobiles have been practically abandoned. Henry Bartol, a former Philadelphian, now living in Nice, Italy, has for three years, Professor Marks said, devoted his attention to gasolene motors. With his servants and family Mr. Bartol has been traveling over the mountains at the rate of 100 miles a day, making an aggregate rise of 20,000 feet on the trip without experiencing any difficulty. In the general discussion, in which half a dozen or more gentlemen took part, it was said that the chief objection to the gasolene motors in Paris is their offensive smell. Electric automobiles, one speaker asserted, have their best field in the cities for pleasure riding and for commercial cab purposes, because the batteries can be readily recharged.

Pittsburg, Pa., Dec. 30, 1899.

MR. C. L. MAGEE, the president of the Consolidated Traction Company, of this city, who has been in Philadelphia for several months under the personal care of a physician, has so far recovered that he was able to come to this city during the holidays and spent Christmas was his family.

MR. FRED DE LAND, of the Federal Telephone Company, has recently purchased the Apollo Telephone Exchange, the Pennsylvania Telegraph & Telephone Company, the Kiskeminitas Valley Telephone Company and the Home Electric & Telephone Company. The Federal Company is now negotiating for the Greensburgh Telephone Exchange.

DIRECTOR E. M. BIGELOW, of the Department of Public Works, has let the contract for electric lighting during the coming year to the Allegheny County Light Company, as follows: Sixty dollars per lamp per year for 1000-cp lamps; $96 for 2000-cp lamps per lamp per year. The arc lights in the park, which are of 1000-cp, will be paid for at the rate of 24¾ cents per hour.

ACCIDENT TO A NIAGARA GENERATOR.—One of the new 5000-hp generators for the Niagara Falls Power Company was being tested at the Westinghouse shops at East Pittsburg when a part of the machine burst, hurling chunks of metal all around the shop with great force. Five men were injured by the flying pieces. The machine was running at a high rate of speed at the time of the accident.

ALUMINUM WIRE.—The Pittsburg Reduction Company has received an order for 60,000 pounds of aluminum from the Chicago & Northwestern Railway Company. The aluminum will be made into wire and the railroad people will use it for telegraph and telephone purposes. The Pittsburg Reduction Company has completed a private telephone line between its head office in this city and the works at New Kensington. This line is made out of aluminum wire, and it is the first aluminum telephone line in this section.

PROF. REGINALD A. FESSENDEN, his assistant, Prof. S. M. Kintner, and Henry W. Fisher, of the Standard Underground Cable Company, of this city, yesterday gave the first practical demonstration of wireless telegraphy in this section by sending a message from a tall building on Penn avenue, Pittsburg, to the observatory in Allegheny, a distance of two miles. After the test Professor Fessenden stated that the result had convinced him that wireless telegraphy can only be utilized successfully in open space or on water.

Cleveland, O., Dec. 30, 1899.

THE ELECTRIC CONTROLLER & SUPPLY COMPANY, of Cleveland, manufacturer of controllers, electric crane equipment, electric brakes and electric lifting magnets, has increased its capital stock from $30,000 to $50,000.

MR. J. M. MILLER, succeeding S. L. Nelson, assumed the position of manager for the Springfield Street Railway and the Springfield Electric Light Company on January 1, acting for the American Railway Company, of New Jersey, which purchased the two plants a few weeks ago.

TELEPHONE EXTENSIONS.—The Columbiana County Telephone Company is at work putting in exchanges and toll lines in East Liverpool, Wellsville, Salem, New Lisbon, Leetonia and Columbiana. The company is also trying to secure a franchise for a system in Alliance, Stark county.

MR. HANNA AND HIS RAILWAY EMPLOYEES.—The seven hundred employees of the Cleveland City Railway Company, who were presented with a Christmas present of $5 each at the suggestion of M. A. Hanna, president of the company, have forwarded a set of resolutions to the Senator thanking him for his kindness and assuring him that in recognition of his fair and just treatment the company may expect faithful and honest service in the future as in the past.

THE WARREN & NILES TELEPHONE COMPANY is making extensive improvements in its equipment. One hundred telephones have been put up within the last ninety days, making a total of 600 instruments in Warren alone. At a recent meeting of the directors of the company it was decided to place a contract for the latest type of multiple switchboard manufactured by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago. The board will have a capacity of 1,000 drops, and the price for it is said to have been $10,000. New cable equipment will also be purchased.

A SERIOUS BURNOUT.—The big 2400-kw unit at the new power house of the Cleveland Electric Railway Company was burned out last Monday morning, badly crippling the company's system. Every available piece of apparatus has been called into service to make up for the loss of the machine, but one line has had to be abandoned for the time being. There seems to be a great difference of opinion as to what caused the accident, and representatives of the General Electric Company, who built the machine, claim it was badly overloaded. The machine will be rewound in about ten days.

NOT TO MAKE AUTOMOBILES.—The New York & Ohio Electric Company, of Warren, manufacturer of the Packard lamp and transformer, has been considerably annoyed of late by reports that it is experimenting with electric automobiles, and is preparing to go into the manufacture of these vehicles. Mr. J. W. Packard, vice president of the company, informs the writer that the reports arose from the fact that he is the owner of a gasolene vehicle and in a private way he is making some experiments with gasoline engines. Whether this will take commercial shape has not been decided, but at any rate the company has no intentions of going into the manufacture of motor vehicles of any kind.

ALUMINUM WIRE IN TELEPHONY.—The Interstate Telephone Company, of Cleveland, has recently completed the installation of telephone exchanges at Shelby and Galion, and is putting in an exchange in Lancaster. The instruments used in these exchanges are the product of the North Electric Company, of this city. The two exchanges have about 250 subscribers each, and are somewhat distinctive, from the fact that they are equipped with aluminum wires, claimed to be the first used for telephone purposes in this State. An official of the company stated that they were very much pleased with the results of the experiment. The aluminum wire costs less and is considerably less expensive to handle than the copper wire.

PROSPERITY OF THE WARREN ELECTRIC & SPECIALTY COMPANY.—Last week the Warren Electric & Specialty Company, of Warren, completed a large addition to its plant, and in honor of the event gave a reception and banquet to its 275 employes. The new building is 135x30 feet and increases the aggregate floor space of the company to 35,000 square feet, all occupied in the manufacture of Peerless incandescent lamps, fan motors and transformers. The officers of the company will occupy a portion of the building, while the balance will be occupied by the transformer and fan motor departments and the assembling room. In an address to the employees, President T. H. Gillmer, of the company, stated that the sales for the past month were 50 per cent. greater than any month in the company's history, and that by March 1 probably 300 hands would be employed, against 130 a year ago.

THE CLEVELAND & EASTERN ELECTRIC RAILWAY commenced operations with its own power last Thursday. For the past two months a portion of the line has been operated by steam and the balance by leased current. The new power house at Gates Mills is at present being operated by temporary equipment, but the permanent equipment will be ready in about two weeks. The power house is being installed by the Arbuckle-Ryan Company, of Toledo. The equipment consists of two 500-kw Siemens & Halske generators direct connected to two 600-hp Russell engines, and two 150-kw Siemens & Halske boosters. The first order of eight cars, built by the Jewett Car Company, of Jewett, O., has been received. These cars are fitted with four 50-hp motors, the product of the Lorain Steel Company, of Lorain, O. They are also equipped with the Magan storage air brake, and electric headlights, furnished by the Adams & Westlake Company, of Chicago. The latter are so powerful that they have to be shaded while within the city limits. The new line extends from the Public Square, Cleveland, to Chardon, 22 miles, with a branch to Middlefield, a total of 47 miles. The construction work was done by the company, Thomas Callahan having been superintendent of construction up to two weeks ago, when he met with a fatal accident. He has been succeeded by J. R. Curtiss. The overhead work was done by the Chase Construction Company, of Detroit, and is pronounced by experts to be a very fine piece of work. On the Middlefield branch the company is experimenting with aluminum wires, double the size of the ordinary copper wire. Incidentally it may be stated that aluminum is being tried on the Cleveland-Berea branch of the Cleveland, Elyria & Oberlin Electric Railway with pronounced success.

WESTERN NOTES.

Chicago, Ill., Dec. 30, 1899.

MR. MAX BERG, of the Ohio Brass Works, Mansfield, Ohio, is visiting Chicago this week.

NEW EDISON STOCK.—An issue of $1,000,000 new stock will be made on Feb. 1 by the Chicago Edison Company. Stockholders of record Jan. 25 can secure the stock at par. Each holder can subscribe for 20 per cent. of his ownings.

MR. A. J. OEHRING, who was connected with the Western Electric Company for many years, and who is now superintendent of the Dearborn Lead & Zinc Mining Company, of Galena, Kan., is in Chicago, on a short visit before making an extended trip in the east.

MAIL AUTOMOBILES.—Automobiles are to replace horses in the Chicago post office service in transferring the mail from station to station and to and from the railroad stations. Mail wagons of the latest pattern have been turned out, and an official test has been made of the new vehicles. Postmaster General Smith, after viewing the work of the new wagons, recommended that contracts be awarded for the service here.

MEETING IN NEW YORK OF INDEPENDENT TELEPHONE INTERESTS.—It is stated that representatives of all the principal independent telephone manufacturers in Chicago, except the Western Telephone Company, are to meet in New York City next week with the avowed purpose of entering a combination that is to embrace all the independent telephone manufacturing concerns in the country. The Chicago concerns that are said to be interested in the deal include the American Electric Telephone Company, Kellogg Switchboard Company, Stromberg-Carlson Telephone Manufacturing Company, Victor Telephone Manufacturing Company, and several others. The plan as outlined by the promoters is to pay for the independent plants in money and preferred stock, leaving the individual management undisturbed. S. M. Bailey, of Chicago, has been active in securing options on the local plants for the proposed combination, but it is said that most of these options have expired and that an entirely new deal is on foot. Vice-President Hamburger, of the Western Telephone Company, it is stated, admitted that such a deal was on, but said his company declined to yield. From other sources it is learned that the promoters have the utmost confidence in embracing all the independent Chicago plants in the new combination shortly after Jan. 1. It is stated in this connection that the consolidation will not include any of the New York concerns.

Indianapolis, Ind., Dec. 25, 1899.

PROFITABLE MUNICIPAL OWNERSHIP.—The municipal electric light plant at Goshen is shown by recent report of the committee to pay a profit to the city of nearly $300 per month.

SUBSIDY ELECTION ORDERED.—An election has been ordered in Lawrence township for Jan. 10, for the purpose of voting on the question of a subsidy for the Indianapolis-Fort Wayne electric or steam railroad.

A CITY ENJOINED.—H. G. Bloom, who is constructing a telephone plant at New Paris to operate in connection with the Richmond exchange, procured a temporary injunction against the town council of New Paris, because of attempted interference with his work.

ANOTHER RAILWAY ON PAPER.—An electric line from Greenfield to Knightstown, Soldiers' Orphans' Home, thence to New Castle, Hagerstown and Richmond, is projected. The promoters say eventually the line will be extended to Cincinnati, thus affording a line from Indianapolis to Cincinnati.

INDIANA ENGINEERING SOCIETY.—The board of directors of the Indiana Electrical Engineering Society held a meeting recently at Indianapolis and decided to hold the next annual meeting of the society at Purdue University Feb. 1, 2 and 3, 1900. A. J. Hammond, of Terre Haute, is president, and James B. Nelson, of Indianapolis, is secretary.

RIVAL TELEPHONE COMPANIES CONSOLIDATE.—The Goshen and Elkhart independent telephone systems are to be consolidated. Both home companies are thoroughly equipped and are as strong as the competing Bell exchanges. The articles of incorporation effecting the consolidation have been prepared for filing with the secretary of state. The Consolidated Company will be known as the Home Telephone Company, of Elkhart County. It is intended to eventually include all the independent lines of the county.

TAXATION OF TELEPHONES.—The Indiana tax board is greatly interested in a recent decision of the Ohio Supreme Court, holding that the Bell telephone instruments should be taxed according to their earning capacity. The board insisted on such a basis at their last meeting, but was persuaded not to do so. The board will make the attempt next year. The Bell instruments are leased by independent companies and, in Indiana, they have been held to be personal property. The assessment on personal property is fixed by the assessors of each county and the state tax board can fix the tax valuation only when appeals are taken. Several appeals were made to the state board at its

last session, and the board fixed the valuation of the instruments at $12.50 in such cases. The cost of the instruments is $3.40, and each instrument is leased by the year. The Ohio court holds that if each instrument earns $14 a year over expenses, the cash value on the rate of 6 per cent. will be about $233, and the instrument should be taxed on this valuation. The Indiana law is very similar to the Ohio law.

Milwaukee, Wis., Dec. 28, 1899.

THE SCHLITZ BREWING COMPANY has placed an order with the Milwaukee Electric Company for motors aggregating 48-hp.

THE PEOPLE'S TELEPHONE COMPANY, which is about to get its line ready for operation at West Superior, has had several of its poles cut down by the city engineer. The reason for this action was that the company had put its poles on a certain street leading to one end of the town, whereas its franchise allows it to use the alleys only. Repeated notices had failed to stop the stringing of wires there, but the engineer caused it to stop very suddenly.

A TEMPORARY INJUNCTION was issued by Judge Stone on Dec. 28, to prevent the Michigan Telephone Company from building its long distance line into Marquette. Those procuring the injunction are Peter Y. Ralph and Louise R. Burt, of New York, trustees, and Hiram A. Burt, of Marquette. These are the owners of a large block of property near the southern limits of town. Barring injunctions, the long distance line is expected to be built through to Marquette from St. Ignace the second week in January.

THE CITIZENS' TRACTION COMPANY, of Oshkosh, has been sued by the Falk Manufacturing Company, of Milwaukee, for $16,000, claimed to be due for building the interurban road between Oshkosh and Neenah. The latter company also asks that a receiver be appointed for the Traction Company. The papers were served on Dec. 21. The original contract price for the building of the interurban road was about $180,000; of this amount $130,000 has been paid, leaving $50,000 unpaid. Of this amount the Traction Company claims that it does not owe the Falk Company $16,000, the amount in dispute.

NEW ELECTRIC LIGHT CARBONS.—It is stated that a proposition will be made to this city to furnish it free of charge with a certain amount of a new kind of electric light carbons, so that tests may be made and the advantage of using them, if any there be, may be ascertained. The carbons are the invention of Frederick Hackman, of St. Paul, formerly of this city. It consists of a carbon tubing filled with calcium carbide powder. The effect, it is said, is the production of a light of at least eight times the brilliancy of the ordinary carbon. Mr. Hackman has tried to introduce this carbon in St. Paul, and the board of public works of that city has favored his idea to the extent that in advertising for bids for electric lighting it has specified his carbide carbon. The council also adopted the views of the board of public works in this respect. The proposition was that the company which furnishes the electric lighting for the city of St. Paul should furnish the current, meters should be supplied to determine the amount of current used, and that the company should be paid in proportion to this amount. The claim was made that the calcium carbide carbon light required a considerable smaller amount of current, as demonstrated by tests, and that a great saving would be made by the use of the new carbons. But the Electric Company, it is stated, claimed that by using the new carbon and having the current measured by meters would be unable to run its plant at a profit, because the amount of current to be furnished by it would be smaller on account of the saving of the current. The law permits contracts for lighting the city of St. Paul to be let for only one year, and for that reason Mr. Hackman and the capitalists associated with him did not deem it advisable to erect their own plant at this time. Mr. Hackman proposes to furnish Milwaukee with free carbons with which to make tests. It is explained that the reason this new carbon gives a brighter light than the ordinary carbon is that calcium carbide will generate gas by its uniting with the oxygen of the air, and will burn in conjunction with the regular carbon gas generated by the heat of the electric current.

Minneapolis, Minn., Dec. 29, 1899.

AGAINST A MUNICIPAL PLANT.—The voters of Slayton, Minn., turned down a proposition to bond the town for $20,000 for electric lights and water works by a vote of two to one.

THE SOMERSET TRANSMISSION PLANT.—Work on the 4000-hp, 25,000-volt transmission plant at Somerset, Wis., has been practically stopped for the winter. The dam is about completed, and the power house foundations have been put in.

EXTENDING A MUNICIPAL PLANT.—A six-pole, 220-volt, 50-kw direct current generator direct connected to a tandem compound Ideal engine, together with marble switchboard and instruments, have been added to the municipal plant at Valley City, N. D. The work was done by the Electric Machinery Company, of Minneapolis. An electric motor for operating the city water works pump will soon be added. A novel device is used at this plant for determining the height of the water in the stand-pipe, which is located some distance from the power house. An iron plate, suspended at the top of the stand-pipe and insulated from it, is connected to the ground detector on the switchboard. A full tank shows up as a "ground" at the power house.

St. Louis, Mo., Dec. 30, 1899.

MORTGAGE.—A $500,000 mortgage was filed last week at Alton, given by the Alton Railway, Gas & Electric Company to the International Banking & Trust Company, to secure 40-year bonds.

ELECTRICAL BUSINESS QUIET.—Little is doing among the electrical supply houses. At present they are all taking stock in order to be ready for business when the spring season opens.

THE SALE of the Imperial Electric Light, Heat & Power Company has been completed, and it will soon be put under new management. J. G. White & Co., of New York, are the purchasers, and the firm of Whitaker & Hodgman, brokers, of St. Louis, are interested.

CITY LIGHTING QUESTION.—The portion of the city now lighted by the Missouri-Edison Electric Company with incandescent lamps will be in darkness after Jan. 1. The company has informed the board of public improvements that it does not care to furnish light that it is not sure of being paid for.

THE SUBURBAN ELECTRIC LIGHT & POWER COMPANY has made application to the county court to place all of its county wires underground in conduits. The plant of the company is located at Laclede Junction and it has wires extending to Kirkwood, Webster Grove, Clayton and other suburban towns.

KINLOCH LONG DISTANCE TELEPHONE COMPANY.—This company has, within the last few days, been incorporated with $2,000,000 capital, $1,000,000 paid in. Its object is to operate a long distance telephone in the states of Missouri and Illinois. The incorporators are stockholders in the Kinloch Telephone Company. Papers of incorporation will be filed in a few days. The company will commence building the lines in the spring.

MESSRS. RUMSEY & SIKEMEIER, pumps, plumbers' supplies, machinery, etc., 519 and 521 North Main, have added an electrical department to their business and have placed P. D. Cable, of Cable & Porteous, electrical supply agents, at the head of it as manager. The department will be in operation about Jan. 1. They will carry a full line of electrical goods and will job over the entire country. At present they are preparing a catalogue of over 300 pages to distribute among the trade.

PRESENTATION TO MR. WAGNER.—Herbert A. Wagner, superintendent of the Missouri-Edison Electric Company, who intends to retire from the position on Jan. 1, was the recipient of a handsome testimonial from the employees on Christmas. Frank Herbert, one of the number, assembled the employees and presented Mr. Wagner with a combination piece of bronze statuary and electrolier. Mr. Wagner responded, expressing his thanks to the gathering, after which all partook of a nice collation. About 250 employees participated.

SOUTHERN NOTES.

Memphis, Tenn., Dec. 28, 1899.

THE BROWN ELECTRICAL COMPANY, of Little Rock, Ark., has opened an office in this city, at 34 Madison Street.

THOMAS G. BREWER, of Osceola, Ark., and Mr. A. M. Gibson, are installing a telephone exchange at Luxora, Ark. They have 40 subscribers to start with. Luxora is a growing town, five miles above Osceola, on the Mississippi River.

Richmond, Va., Dec. 30, 1899.

LOCOMOTIVE HEADLIGHTS.—The Southern Railway Company has ordered 41 new locomotives of a locomotive works in this city. They are to be equipped with electric headlights.

CANADIAN NOTES.

Ottawa, Ont., Dec. 30, 1899.

INCORPORATION.—At the next session of the Ontario legislature, incorporation will be asked for the Queenstown, St. Catherines & Port Dalhousie Electric Railway Company.

THE NEW SWITCHBOARD for the Montreal Electric Street Railway, which has been in course of construction for the past nine months, will be completed about the middle of January. It is built of Vermont blue marble, and is a very striking structure. This new switchboard is said to be the largest in America.

THE NIAGARA, ST. CATHERINES & TORONTO RAILWAY COMPANY has placed its order with the Canadian General Electric Company for the railway company's entire motor equipment, consisting of six 4-motor and four 2-motor cars. This railway company has taken over the Niagara Central Railway, with the intention of extending it ultimately to Toronto.

FIRST COST OF MUNICIPAL PLANT.—The committee appointed by the city council of Brockville, Ont., to report on the question of installing a municipal electric light plant, estimates that a suitable plant can be installed at a cost of $30,000. This would include two dynamos, 68 enclosed arc lamps, 121 incandescent lamps, marble switchboard, line wire, engine and boilers.

THE METROPOLITAN ELECTRIC RAILWAY COMPANY, of Toronto, has announced its intention to apply at the next session of the Ontario legislature, for powers to run cars over the tracks of the Toronto Electric Railway Company, to carry both passengers and freight from points in the city. In effect, the application means that a radial system of railway for Toronto, if the power asked for is granted, will be inaugurated upon terms to be agreed upon by the railways concerned, or as may be determined by the Ontario government.

AS A RESULT of a conference between Dr. Hoepfner, of the Hoepfner Refining Company, John Patterson, of the Cataract Power Company, and an expert from the Krupp Gun Works, in Germany, it has been decided to enlarge the nickel ore refinery premises at Hamilton, Ont., by four times its present dimensions. The plant, as it now stands, consists of a main building 236 by 55 feet and three smaller buildings, and, as soon as these are in operation, the enlargement will be proceeded with. The works, when completed, will cover six acres of land, and it will make the refinery works, which is the only one of its kind in Canada, the largest on the American continent. It is estimated that over 4000 electrical horse-power, to be supplied by the Cataract Power Company, will be used daily.

ELECTRIC INTERESTS IN JAMAICA.—A report received from the commercial agent of the Dominion government, in Trinidad, says that a syndicate of Canadian capitalists has already acquired the Electric Tramway Company's rights in Jamaica and the lighting and tramway services in Georgetown, Demerara, and has an option on the electric lighting and tramway of Port of Spain. The application of the Demerara Electric Company for a license to construct

and operate electric tramways and lighting plants in the city of Georgetown, Demerara, has been granted upon terms satisfactory to the company. The capital stock of the company is $850,000. The directors are Sir William Van Horne, Senator Drummond, Abner Kingman, James Hutchison, W. B. Chipman, all of Montreal, and Senator McKean and B. F. Pearson, of Halifax, N. S.

A LARGE CASTING.—One of the largest iron castings that ever came into Ottawa is a mammoth piece of metal, which has just arrived there, consigned to Messrs. Ahearn & Soper. It forms part of the 1800-hp electric generators which the firm is installing in the new power house of the Ottawa Electric Company. Besides the casting, the weight of which is 35,120 pounds, there is another carload of smaller pieces. The remainder of the generator will require four more cars to transport it to Ottawa. The aggregate weight of the generator will be 220,000 pounds, and there is one casting yet to arrive which is still larger than the one above referred to. It weighs 62,000 pounds. These pieces of machinery were manufactured at Pittsburg, Pa., by the Westinghouse Company and are shipped direct from the point of manufacture. It is expected that the generator will be in operation about the latter part of January.

ELECTRICAL DEVELOPMENT IN TORONTO.—The city of Toronto is much exercised over the progress in electrical development which Hamilton, Ottawa, Montreal and other smaller cities in the Dominion are making in comparison with Toronto. The Toronto *Globe*, in a forcible editorial, brings the matter to the attention of the citizens and declares that the city council cannot too speedily realize that the progress of Toronto is seriously checked by its disadvantageous position in regard to the supply of power the city holds as compared with other cities in Canada. The new factory of the National Cycle & Automobile Company, which will employ 1000 hands, has been captured by Hamilton, because the latter city has water-generated electric power to sell at a much cheaper rate than steam-produced power can be sold in Toronto. It is pointed out that not only is Hamilton in a better position in this respect, but so is the city of Ottawa, with its great Chaudiere power; Montreal, with its vast Lachine development, and Quebec city, with the power of Montmorency. The *Globe* says that if the Electric Light Company, now operating in Toronto, fails to take advantage of the development now going on at Niagara, or to secure some other water power from which electricity can be transmitted to Toronto, it will become a question as to whether the city should not seek some other means to supply the great want.

ENGLISH NOTES.

London Office, Electrical World and Engineer, Dec. 22, 1899.

MR. ROBERT T. LOZIER, of New York, has just returned to the States after rather a hurried trip to London and the Continent. Mr. Lozier stated while here that a large number of Bullock motors are now being used in this country, and Messrs. Bergtheil & Young, London agents for the Bullock apparatus, are getting good orders for these machines, as they appear to have certain qualifications and adaptabilities particularly suited to the Englishman's wants.

NORTH OF ENGLAND.—Electrical engineers in the North of England are desirous of forming a local section of the Institution of Electrical Engineers for the counties of Northumberland and Durham, and for that purpose held an animated meeting in the Durham College of Science, Newcastle, which was presided over by Prof. Silvanus P. Thompson. A resolution asking the council to grant the formation of a Newcastle and district local section was unanimously passed and a provisional committee appointed.

DAVID BRUCE PEEBLES.—We regret to have to announce the death of Mr. David Bruce Peebles, the senior member of the firm of electrical engineers which bears his name in Edinburgh, Scotland. Mr. Peebles was born at Dundee in 1826 and was perhaps better known as a gas engineer, having carried on a successful business in this capacity for many years, and his gas engine is well known throughout Great Britain. It is less than two years ago since he turned his attention to electricity, but with his accustomed energy he soon surrounded himself with capable electrical engineers as his associates, and before his death had the satisfaction of knowing that his was the largest electrical factory in Scotland. Its history is little short of marvelous, as in a period of little more than a year several hundred generators and motors have been supplied, and already a large number of the corporations have ordered machines from this enterprising firm, both for electric lighting and for tramway work. Mr. Peebles will be much missed in the North, where he had the entire respect of the community, having become widely known through his contributions to scientific papers, to the Gas Institute, Royal Scottish Society of Arts and to the Royal Society of Edinburgh.

ELECTRICITY WORKS FOR HEREFORD.—The ancient and historical city of Hereford, on the Wye, is now equipped with electricity works, and Mr. W. J. Humfrys, mayor of the city, amid great enthusiasm, formally opened them on the 14th of this month. The plant, as are most of the electricity works in Great Britain, is owned by the city, and has been constructed in the comparatively short time of about seven and one-half months. The contract price for the whole amounted to about $100,000, the machinery costing somewhat more than half that amount, being furnished by the India Rubber, Gutta Percha & Telegraph Work Company, of Silvertown, who provided the boilers, engines, dynamos, switchboards, battery and cables. The station consists of a boiler room 50x44 feet, a generating room 30x39 feet, and an accumulator room 30x44 feet, with suitable offices. Space has been provided for three Lancashire boilers 30x7.5 feet, two of which are now installed, and which work at a pressure of 160 pounds. They are fitted with Meldrum's forced draught, Green economizer, feed pumps, etc. The boilers are of steel, and were made and erected by R. Taylor & Sons, of Marsden, Yorks, and the engines, of which there are two, are of the Belliss compound two-crank type, fitted with forced lubrication to all working parts, and each capable of developing 150-hp at 450 revolutions per minute. Each engine is direct coupled to a Silvertown undertype shunt wound dynamo, of 440 to 500 volts and 200 ampere capacity at the normal speed. The steam consumption of each set at full load is about 22 pounds per electrical horse power. A ten-ton crane is provided to run the entire length of the engine room. The balancer and the booster are coupled together and run at a speed of 800 revolutions per minute, the balancer being of the Silvertown S. D. 40 type, capable of supplying 100 amperes to either side of the three-wire system at any voltage between 220 and 270 volts, the booster being capable of carrying 90 amperes at any voltage between 20 and 90 volts. The switchboard, which is mounted on an iron frame 14x8 feet, is arranged for a three-wire supply, at a pressure between the outer circuits of 440 to 500 volts, and is fitted with cut-outs, double-pole fuses, ammeters, voltmeters, etc. Weston voltmeters are fitted on the feeder circuits and Kelvin multi-cellular instruments for the dynamo, battery and booster. Two hundred and seventy accumulators of the "chloride" type are provided, each in a glass box, and each having a capacity of 660 ampere hours. The cables as supplied by the Silvertown Company are insulated with vulcanized india rubber, protected with tape, and are laid under the roadway in wooden troughing filled in with bituminous compound. The scale of charges has been fixed at 12 cents per unit for the first two hours and 8 cents afterwards on the maximum demand principle, the uniform charge for power being 6 cents per unit.

FOREIGN NOTES.

City of Mexico, Mexico, Dec. 23, 1899.

THE TOPO CHICO STREET RAILWAY line in the city of Monterey is being extended to the Mexican International Railroad depot. This line was purchased a few months ago by Mr. S. W. Slayden, a capitalist of Waco, Texas.

THE STREET RAILWAY SYSTEM in the city of Morelia is being extended two miles, to reach the state penitentiary and Bosque de San Pedro. In addition to the extension now being made, it is proposed to make extensive improvements in equipment, etc.

AMERICAN TELEPHONE EQUIPMENT.—Representatives of the Compania Telefonica Jelisciense, of the city of Guadalajara, have been in the United States for the past few weeks purchasing equipment for the new telephone system that is to be established in Guadalajara.

ELECTRICAL INVESTMENTS IN MEXICO.—An official report on the progress of electricity has been made for the Mexican government by Messrs. Siemens & Halske. It shows that the capital now invested in electrical appliances, lighting, etc., in Mexico, now exceeds $100,000,000.

ELECTRIC LIGHT IN CHILPANCINGO.—Governor Monasterio, of the state of Guerrero, recently purchased a complete electric light plant, and has installed same in the city of Chilpancingo, the capital of the state. It will be placed in operation about Jan. 10 and will furnish lights for the city.

TO DEVELOP WATER POWERS.—Mr. Jose Castellot, a well known capitalist, has applied to the federal government for a concession to utilize the various falls on the Tula River, between Tepeji del Rio and Dublan, for motive power. He proposes to install electric plants and erect and operate a large factory.

ELECTRIC LIGHT IN TEPIC.—Mr. M. P. King, a well known civil and electrical engineer, has entered into a contract with the municipal authorities of the city of Tepic to construct an electric light plant there. Mr. King states that the machinery, etc., for the proposed plant will be purchased in San Francisco and shipped to Tepic by boat down the Pacific coast.

THE CITY OF PARRAL, in the state of Chihuahua, is having a rapid growth since the completion of the Mexican Central branch railroad. Two companies of local capitalists have applied to the state government for a concession to establish an electric light plant in the town. The work of constructing the new plant will begin as soon as the concession is granted.

STREET RAILWAY IN URUAPAM.—A company of local capitalists has been organized at Uruapam, state of Michoacan, for the purpose of immediately constructing and operating a street railway in that place. The Mexican National Railroad was recently extended to Uruapam, and there is much activity in building and other substantial improvements going on there. The material for the construction of the street railway system has already been purchased.

PRESIDENT DIAZ OPENS A POWER PLANT.—The new electric plant of the Federal District Street Railway Company, in this city, was recently formally inaugurated. The machinery was started by President Porfirio Diaz, who visited the power station for that purpose and to personally inspect the plant. President Diaz was accompanied by several other distinguished government officials, and the entire party evinced much interest in the machinery, etc. Mr. T. T. Randolph, a well known electrical engineer, has charge of the plant.

MAXIMUM PASSENGER LIMIT.—The governor of the federal district, in which the City of Mexico is situated, has issued orders to the police not to allow more than 40 passengers on any one street car in this city. Whenever a policeman observes a car unusually full of people he is authorized to stop the car, count the passengers, and, if there is more than 40, to make the excess number get off the car. The question has been raised as to who the policeman shall put off the car when he finds over 40 persons aboard. All have paid their fares, and what is to become of the fares if those who have paid them are not allowed to ride on the car?

IMPROVING CHIHUAHUA'S STREET RAILWAY.—The street railway system in the city of Chihuahua is being reconstructed and extended to more than double its present length. The improvements embrace the construction of a belt line between the station of the Mexican Central Railroad and the present terminus at the Plaza Principal, with an extension of the line to the depot of the Chihuahua & Pacific Railroad. The total length of the system when completed will be 9½ kilometres (six miles). The company has also purchased 15 new cars for the system. The improvement work is in charge of Mr. John E. Earley, a civil engineer of the City of Mexico.

MEXICAN STREET RAILWAY PROPERTIES.—Street railway systems in the principal cities of Mexico are evidently considered good property by in-

vestors. There has been considerable activity in that line in this country during the past few months. In addition to the recent sale of the street railway systems of Guadalajara and Puebla, it is now announced that the extensive system at San Luis Potosi has been sold to the electric light company of that city. The new owners propose to convert the system into an electric one as soon as the necessary material and machinery can be purchased. San Luis Potosi is a city of about 80,000 population, and is the capital of the state of that name. The Electric Light Company is composed of American capitalists. The electric light plant was a losing concern for several years, until it was acquired by its present owners, who made many improvements and have placed it on a paying basis.

General News.

THE TELEGRAPH AND TELEPHONE.

COLUMBIA, S. C.—The South Carolina Telephone Company, which was recently incorporated, is about to begin the construction of its plant. Mr. Jerome Bradley is vice-president.

SMITHFIELD, VA.—The Isle of Wight Telephone & Telegraph Company is building a metallic copper circuit to Norfolk. It will ask for permission to increase its capital stock to $25,000.

BARNWELL, S. C.—The Southern Telephone & Telegraph Company has installed an exchange in this place. It will work in connection with the American Telephone & Telegraph Company's system.

WILMINGTON, DEL.—The American Independent Telephone Company has been incorporated to construct and operate telephone and telegraph lines. Capital $100,000. Incorporators, E. T. Canby, C. W. Smith, J. L. O'Neill, all of Wilmington.

LAMONI, IA.—The Lamoni Telephone Company has been incorporated here, with a capital stock of $5000. The company succeeds to the business carried on by Bert Teale and W. A. Hopkins, under the name of the Lamoni Telephone Exchange.

JOHN ADAMS, CAL.—The Independent Telephone Company has been incorporated to operate telephone lines. Capital $10,000. Incorporators, C. H. Hintz, H. A. Hintz, J. Adams, all of John Adams; B. E. Walker, M. V. Roe, A. L. Nichols, L. Bond, all of Minshew.

YORKTOWN, VA.—The Chesapeake Telephone & Telegraph Company has been incorporated by E. E. Slight, B. F. Crockett, E. S. Morse, of Crab Neck, and others. The capital stock of the company is $20,000. Twenty-seven miles of line will be built at a cost of about $1400.

LOUISVILLE, KY.—The American District Telegraph Company, of Kentucky, has been incorporated with a capital stock of $150,000 to establish a district messenger service, telephone system and automatic fire alarm system in Louisville. The incorporators are H. P. Bennett, of Columbus, O.; Charles H. Gibson and Charles Smith.

PACIFIC STATES TELEPHONE COMPANY.—President John I. Sabin, of the Pacific States Telephone Companies, has issued a circular to the effect that the Sunset Telephone & Telegraph Company (Bell telephone) has purchased the property of the People's Telephone Company, of San Jose, Cal., an independent company. The original stockholders in the opposition telephone company in San Jose are stated to have lost every dollar they put into the business, the company having been sold out for debt and the new stockholders who purchased the old company for the amount of its outstanding indebtedness have now sold out to the Sunset Company for a sum less than that for which the property was knocked down under the hammer.

DENTON, MD.—The Eastern Shore Telegraph & Telephone Company, of Caroline County, has been incorporated, with a capital stock of $100,000. The incorporators are Thomas L. Day, William H. Deweese, James A. Trazzare, Fred R. Owens and Jacob E. Ellwanger. The following officers were elected: Harry A. Richardson, president; Thomas L. Day, vice-president; Fred R. Owens, secretary; Dupont Walker, treasurer, and Deweese & Owens, of Denton, counsel. The organization of this company probably means the consolidation of all the Eastern Shore lines with the Diamond State Company, of which Mr. Richardson is also the president. Substantiation of this seems to be found in the fact that the directory is composed of gentlemen interested in the different telephone companies of the Shore. Mr. Woolford is president of the Dorchester Company, while Mr. Day owns the Union Telephone Company, of Talbot, and 27 miles of line in Dorchester, besides with Mr. Owens and others being interested in the Bee line, which holds valuable franchises in Caroline and several counties.

ELECTRIC LIGHT AND POWER.

DULUTH, MINN.—An election will be held here in February to vote on the question of erecting a 500 arc light plant.

TOPEKA, KAN.—The State Charter Board has granted a charter to the Pittsburg Electric Light & Power Company.

LOWELLVILLE, O.—An electric light plant will be installed in this place by the authorities. Hon. P. Watson is mayor.

WAUKEGAN, WIS.—The Waukegan Electric Light Company, with a capital of $60,000, has been licensed in Illinois for the same amount.

CHARLESTON, IND.—An electric light plant and water works are to be installed here at a cost of about $10,000. Mr. C. R. Hayes is the engineer.

DOWNER'S GROVE, PA.—The Downer's Grove Electric Light Company, Downer's Grove, has been incorporated. Capital $2500. Incorporators, W. A. Tope, Jake Klein, W. H. Edwards.

CRIPPLE CREEK, COL.—The People's Electric Company, of Cripple Creek, has been incorporated with a capital of $50,000. Incorporators, M. S. Boal, H. L. Shepherd, E. Bell, all of Cripple Creek.

PORTLAND, ME.—The Mollis Electric Company, of Portland, has been incorporated. Capital $50,000. Incorporators, W. K. Dana, L. Lane, E. J. Haskell, W. W. Poole, R. D. Woodman, J. C. Scotes, all of Westbrook.

JEFFERSON CITY, MO.—The Home Electric Light & Power Company, of Kansas City, has been incorporated with a capital stock of $2000. The incorporators are B. Corrigan, G. E. Green, J. B. Porter, W. B. Teasdale, all of Kansas City; C. S. Sweetland, of Providence, R. I.

MIAMI, I. T.—Ordinances have been passed by the council of the town of Miami, I. T., granting to John M. Murphy and Charles M. Dobson, of New York, the right to construct and operate systems of electric lights and power and water works. Work must be begun on both plants within sixty days, and completed on or before July 1, 1900.

THE ELECTRIC RAILWAY.

MEMPHIS, TENN.—The Memphis Street Railway Company on Christmas day inaugurated the transfer system on its lines. It is now possible to ride from any point in the city to any other point traversed by the street railway, for one fare.

PINE BLUFF, ARK.—M. Roberts and John Georgian, of Independence, Mo., have offered to construct an electric street railway, also a lighting plant, at Pine Bluff, on certain conditions. It is probable that the charter will be granted.

ATLANTA, GA.—The Atlanta Railway & Power Company will build several extensions in the city, permission having been granted to it for that purpose by the city authorities.

COLUMBIA, S. C.—The Columbia Electric Railway Company, it is stated, will build several miles of new lines in the suburbs in addition to making improvements to the present system.

MACON, GA.—The North and South Macon Railway Company has been organized for the purpose of building a street railway in the suburbs of the city. Among those interested in the enterprise are W. B. Sparks and Hon. H. C. Bacon.

ELIZABETH, N. J.—The Elizabeth & Westfield Trolley Company has accepted the franchise awarded the company a month ago to operate a trolley road in Jersey avenue. The franchise provides that the company may charge only a five-cent fare from Roselle to Elizabeth and issue transfers good over the North Jersey lines in Elizabeth and an eight-cent fare from Cranford, but after five years it must be reduced to five. The company has eight months in which to build the road.

CLEVELAND, OHIO.—The Little Consolidated Railway will secure additional power. Plans are now being considered for more machinery for the company's power house, which is located on the flats. A new engine will be purchased at a cost of about $60,000. A plan is under consideration whereby the two street railway companies may join forces in the matter of power. The Big Consolidated wants to enter into an agreement under the terms of which it will furnish all the power for the cars operated east of the river, while the Little Consolidated will furnish the power for the cars on the west side of the river. The Little Consolidated will shortly expend about $150,000 for new cars. Thirty-five new closed cars, 30 feet "in the clear," will be purchased at an average cost of $4200 each. The first of the cars will be delivered in March.

PERSONAL.

MR. FRANK W. ROLLER, of the well known electrical firm of Machado & Roller, of New York City, was married on Christmas Day to Miss Katharine Nichols, at Newark, N. J. A host of friends extend their hearty congratulations and warmest wishes to the happy pair.

PROFESSOR ROENTGEN, of Würzburg, the discoverer of the X-rays, has finally accepted a call to Munich University that was extended to him some months ago. There were certain conditions laid down by the scientist that have only recently been agreed to by the larger university.

MR. GUIDO SEMENZA, electrical engineer of the Milan Edison Company, who lately spent three or four months investigating central station work in this country, has gratified many friends whom he met here by sending them news of his marriage, on Dec. 19, to Miss Nelly Pandiani.

MR. H. N. GIFFORD, late general manager of the Ohio Valley Telephone Company, Louisville, Ky., asks us to contradict the reports that have been current, crediting him with the intention of connecting himself with an independent telephone organization in that city. Mr. Gifford says it is a mistake and that he is not interested in any new company.

MR. ROBERT W. BLACKWELL, with a large party of business associates and friends, including Messrs. Moncks, Lomas, Parshall, Borman, etc., has just returned to London from New York, where he succeeded in adjusting a great many important business matters and in laying plans for an extension of his already large engineering connection.

OBITUARY.

MR. JAS. HAMBLET, who since 1878 has been in charge of the Western Union time service in New York City, died of pneumonia on January 2 in Brooklyn at the age of 75. A biography will appear of this estimable man in our next issue.

LEGAL.

TELEPHONE TAXATION.—The decision of the Ohio Supreme Court holding that the telephones of the Bell Company shall be taxed on their rental value instead of their actual cost, is one of the most important rulings on the subject of taxation that has been handed down since that which sustained the validity of the Nichols law, taxing franchises. The decision in the telephone case is, in effect, simply an extension of the general principles of taxation upon which the Nichols law is based. Manifestly it will be far-reaching in its effect. If telephones are taxed on their rental value, it is apparent the same method of valuation will apply to every device operated in a similar manner. The Bell telephones are not sold outright. They are rented to the Central Union Company, which operates them in Ohio. The actual cost of each telephone is said to be about $3.40, and heretofore they have been listed at this valuation for taxation. The Bell Company exacts a rental of $14 a year, net, for each telephone, four times its actual cost. Computed on the legal rate of interest, the rental value of each telephone would be $233. Whether they shall be listed at this figure, or only two-thirds of it, in conformity with the general rule of appraisement of property for taxation, is not known. It is expected that this and other important points involved will be elucidated in the decision, which is to be reported fully.

Trade and Industrial Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, states that one of the largest packing houses in the country, after a severe test of all makes of wires, has adopted Paranite rubber-covered wire, for the entire installation.

THE TUCKER ELECTRICAL CONSTRUCTION COMPANY, New York City, has removed its offices from 14 Whitehall Street to the Curtis Building, 35 South William Street and 31 Stone Street. This concern claims to be the oldest electrical engineering and construction company in this city, having started business in the spring of 1887.

THE CUTLER-HAMMER MANUFACTURING COMPANY, Milwaukee, Wis., reports that its business has increased to such an extent that it has made arrangements for a three-story addition, 50 by 75 feet in size, which will be ready for occupancy in about two months. The company's present quarters are about twice as large as those it occupied in Chicago.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Chicago, reports a steadily increasing demand for the regular individual generator call and local battery telephones for exchange and long distance toll line work in old-established systems, and that with its present greatly enlarged manufacturing facilities, it is in a position to fill all orders promptly.

"ELECTRA" CALENDAR.—Mr. Hugo Reisinger, 11 Broadway, New York, importer of "Electra" carbons, is presenting to his patrons a daily calendar for 1900. There is a pad of sheets, one sheet for each day. The pad is mounted on a red leather card, which is arranged to stand on the desk, easel-fashion. The calendar will remind one of the fact that time is fleet, and that Electra carbons are among the best means of turning night into day.

BARGAIN SHEET.—Messrs. Thompson, Son & Co., 107 Liberty street, New York, have issued their January, 1900, bargain sheet. The "sheet" is in reality a booklet of 28 pages of printed lists and prices of electrical apparatus and appliances. The lists include incandescent and arc lamps, motors, dynamos and generators, alternators, transformers, meters, switches, etc. They also have a list of railway material, engines, boilers and steam apparatus in general. This firm will be pleased to hear from any one interested in this line.

GAS AND KEROSENE ENGINES.—Messrs. Mietz & Weiss, 128 Mott street, New York, are represented in Europe by Markt & Co., Ltd., London, Hamburg and Paris. They make gas and kerosene engines that regulate so well that they can be belted or direct coupled to a dynamo for lighting, charging storage batteries, and all power purposes. These engines were fully described and illustrated in these columns in the issue of December 2, 1899. The firm does not make gasolene engines, confining itself to the manufacture of gas and kerosene engines.

THE WESTERN ELECTRICAL SUPPLY COMPANY, of St. Louis, report that the success of their now well-known brand of "Monarch" incandescent lamps has been extremely gratifying. They have spared neither time nor expense to produce a lamp that was first-class in every respect, and state that in this type they have one which they can guarantee fully as to the life, current, consumption, efficiency and sustained candle power. They say that wherever they have placed these lamps they have been entirely satisfactory, as evidenced by the numerous duplicate orders received for them.

ENGINEERING INSTRUCTION is being given with great success by the Electrical Engineer Institute of Correspondence Instruction, 120 Liberty street, whose work has been especially devoted to electrical engineering. Its students are scattered all over the world, and are increasing rapidly. Its instruction papers have been prepared by the most eminent teachers and experts in the electrical field, and have proved to be admirably adapted to their purpose, Mr. Thomas A. Edison giving the Institute his emphatic personal endorsement. The management of the Institute inform us that their work and plans will be carried out on a broader basis than ever in 1900. Its literature and terms will be sent upon request to any address in any part of this country or abroad.

WILLIAM ROCHE, manufacturer and inventor of the well known "New Standard" dry battery, exhibits with a great deal of pride, testimonials as to the efficiency and long life of his batteries from all over the world. Among them the following might be mentioned: Racine Boat Manufacturing Company, Sault Ste. Marie, Mich.; A. H. Patterson, professor of physics and astronomy, University of Georgia, Athens, Ga.; Standard Telephone & Electric Company, Madison, Wis.; Noyes Bros. & Cutler, St. Paul, Minn., and Prof. W. J. Herdman, University of Michigan, Ann Arbor, Mich. The foreign branch of this house, 46 Clerkenwell Road, London, England, under the management of R. E. Howard, reports business increasing at an enormous rate in the sale of "New Standards."

THE O. C. WHITE COMPANY, Worcester, Mass., in a 38-page pamphlet just issued illustrates and gives a brief description of the uses of its line of standard adjustable fixtures for incandescent lamps. These devices are designed for use in the shop, mill, factory, draughting room, office, bank, house, library and dressing room. By their use the light is brought to bear from just the point desired relative to the object, instead of the object having to be placed relative to the light. The lamp is thus placed in the most effective position and this is accomplished instantaneously. The lamp remains in any position in which it is placed, no attention whatever being required for fastenings. These fixtures have been on the market for several years, and have received public approval.

THE CLING-SURFACE MANUFACTURING COMPANY, Buffalo, N. Y., reports that it is receiving daily favorable reports from users of Cling-Surface and that sales are increasing steadily. The C. Pardee Works, Perth Amboy, N. J., says: "Cling-Surface gives entire satisfaction and does the work better than anything we have ever used." The Mississippi Cotton Oil Company, Grenada, Miss., writes: "Have broken three crusher shafts by tight belts; after three applications of Cling-Surface could run crusher with very loose belts." The Forehand Arms Company, Worcester, Mass., says: "Have 24-inch belt, 35 feet between centres, running with 18-inch sag, and giving perfect satisfaction. Before using Cling-Surface were obliged to keep this belt very tight and were much troubled by its running off."

THE SCRANTON SCHOOLS.—The rapid growth and remarkable popularity of schools of correspondence prove that this new system of education meets a distinct want. Starting about ten years ago with a single course in mining, the International Correspondence Schools of Scranton, Pa., have developed so rapidly that they now teach by mail over seventy courses and have over 130,000 students on their rolls. Most of the students are residents of this country and Canada, but the schools have a large following in foreign lands. Students in twenty of the Mexican States are enrolled in the schools, and almost as many European countries are represented. That no country is too remote to be reached by the correspondence school is shown by the records of students in South Africa, Australia, Tasmania, Siam and Korea, who are successfully educating themselves through the courses of the International Correspondence Schools.

INDEPENDENT TELEPHONE COMPANIES throughout the United States have urged the different manufacturers to get out a transmitter and receiver equal to the American Bell long distance transmitter and receiver. It remained for the Swedish-American Telephone Company, of Chicago, they claim, to fill this vacancy. Their transmitter is guaranteed for five years, and is asserted to be equal to that of the Bell long distance transmitter in every respect, and superior in some, while not less strong claims are put forward as to the receiver. A full line of telephone apparatus will shortly be placed on the market, but at present they are ready to fill orders for transmitters and receivers. Mr. S. W. Moon, formerly general manager of the American Electric Telephone Company, is general manager, secretary and treasurer of the new company. "High class apparatus and a fair price for the same" is the motto of the new company.

BRASS HANDLE FOLDING POCKET FLOOR GROOVER.—The Western Electric Company is placing upon the market a new floor groover, the blade of which is very similar in appearance to the stiff-handled floor groover which has been used for some time. A novel and peculiar feature of this new floor groover lies in the fact that the blade can be folded back into the handle like the blade of a pocket-knife. The point fits into a socket, the edge of which comes in contact with the back of the floor groover, thus preventing the point from being worn. When folded, the greatest dimension is 3¼ inches, and it can be carried handily in the pocket. Or, if the tool is thrown into the handbag of the workman with other tools, the point is protected by the socket into which it fits, thus making it impossible for the other tools to spoil the edge. The handle of the floor groover is made of brass, and is of a convenient size and shape which fits the hand.

THE WILLARD AUTOMOBILE STORAGE BATTERY.—Messrs. Sipe & Sigler, Cleveland, Ohio, have just issued a neat little pamphlet on the Willard automobile storage battery which is manufactured by them. The pamphlet contains 32 pages of interesting matter on this subject, including an illustration of a cell of the battery and a diagram of charging connections. The advantages of the battery are set forth and tables give the dimensions, etc., of the various sizes of cells. A specially interesting chapter of this pamphlet is that devoted to a discussion of the future of electric vehicles; it gives a good deal of timely information on the subject. Carefully prepared instructions for the care and maintenance of the Willard automobile battery are also given. Messrs. Sipe & Sigler do not confine their activities to the manufacture of automobile batteries alone. They make Willard batteries for all purposes, including heavy and stationary work. The pamphlet in question relates only to the automobile battery, which is an important part of the firm's business.

THE BELDEN SYSTEM.—The Belden-Larwill Electric & Manufacturing Company, Fort Wayne, Ind., has just issued Bulletin No. 1, which is devoted entirely to a complete description of its 110 and 220-volt enclosed arc lamps for direct current circuits. In design this lamp presents some features that are a distinct departure from the ordinary. The clutch, which is one of the most important points of the lamp, releases itself without striking a trippost of any kind, thereby eliminating the change of voltage every time the lamp feeds. The motion and force given to the clutch rod is said to be absolutely uniform throughout its travel, and the action of the lamp is in every way most satisfactory. The mechanism is simple and light, but strong, and the lamp works perfectly, regardless of alignment. There is an absence of springs, gears and sliding contacts, which greatly simplifies the problem of satisfactory operation. The upper carbon is heavily weighted in order to over-

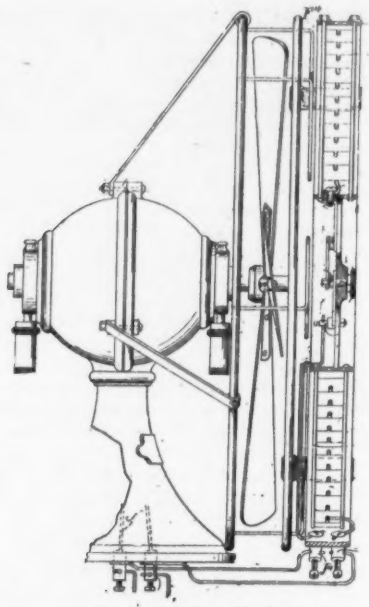
come any possible friction, and the magnet and its mechanism are powerful in order to offset the gravity of the upper carbon. The lamps can be easily retrimmed without removing the inner globe, and, in case of necessity, can be retrimmed while hot. It has a very artistic appearance, which quality will appeal strongly to the user, where the lamp is to be used indoors. It is said to burn economically on both voltages.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED DEC. 26, 1899.

[In Charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

638,966. ELECTRICALLY PROPELLED VEHICLE; R. M. Hunter, Philadelphia, Pa. App. filed Oct. 27, 1886. (Issued Dec. 12.) (See Current News and Notes.)

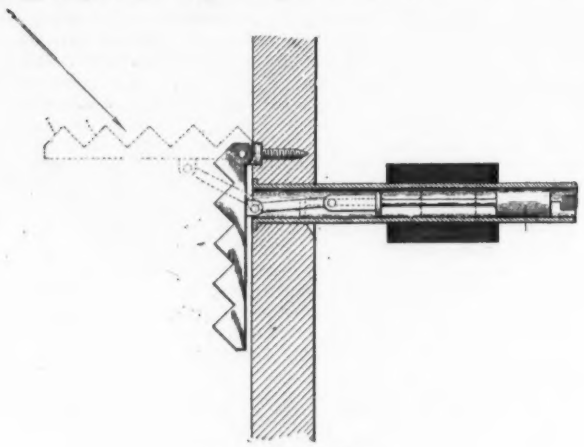


640,143.—Electric Heater.

639,716. TELAUTOGRAPH; F. W. Cushing, Highland Park, Ill. App. filed Sept. 5, 1899. A master switch is adapted to be moved to one position for the transmission of a message and to another position for receiving a message. A signal circuit is arranged to be closed or opened coincidently with the movements of the master switch, and devices are arranged so that with the raising of the arm of the operator after transmitting a message, the signal circuit is completed, so that failure to restore the master switch to receiving position will be indicated.

639,725. ELECTRIC HEATER; E. E. Gold, New York. App. filed June 15, 1898. The heating coil is supported by a strip of material slightly wider than the diameter of the coil, and forced into the coil so as to slightly distend or distort it; the natural pressure thus obtained serving to hold the coil in place.

639,767. CHEMICAL ELECTRIC EXCITANT; J. Post, New York, N. Y. App. filed July 6, 1899. (See Current News and Notes.)



640,153.—Signal Plate.

639,768. TELEPHONE ATTACHMENT; D. Queen, Janelew, W. Va. App. filed Aug. 1, 1899. (See Current News and Notes.)

639,780. ELECTRIC ARC LAMP; H. F. Spies, New York. App. filed March 31, 1899. The electrodes are tipped with platinum and gold fused together.

639,824. ELECTRIC LIGHT APPLIANCE FOR CONTROLLING THE NUMBER OF INCANDESCENT LIGHTS TO BE BURNED ON A CIRCUIT; A. Peters, Manitou, Colo. App. filed June 6, 1899. Details of construction of a switch intended to cut out lamps when more than a predetermined number are in use.

639,830. TELEPHONE INSTRUMENT; J. J. Schoenleher, St. Paul, Minn. Filed April 26, 1897. (See Current News and Notes.)

639,849. PORTABLE HAND DYNAMO; S. Evershed, London, England. App. filed Aug. 25, 1899. A dynamo to be used for testing or for firing fuses and for other purposes where small current and high electromotive force is utilized. The invention relates to specific constructions, whereby frictional resistance to rotation is reduced; the operating handle is collapsible when not in use, and connections with the instrument easily and rapidly effected.

639,860. ELECTRIC RAILWAY; J. McL. Murphy, Torrington, Conn. App. filed April 19, 1899. The third rail is placed in a trough, which is afterward filled in with a cement of high insulating qualities, leaving the surface of the rail exposed.

639,880. TROLLEY; F. F. Adair, Wilmington, Del. App. filed Oct. 16, 1899. A roller is mounted adjacent to the trolley wheel and is held normally out of engagement with the wire by a latch. When the wheel leaves the wire the latch is released and the roller moves into contact with the wire to preserve the circuit.

639,905. ELECTRIC BATTERY; J. Post, New York, N. Y. App. filed July 14, 1899. (See Current News and Notes.)

639,932. TROLLEY; E. Penning-Dupuis, Halle-on-Saale, Germany. App. filed March 2, 1899. A current collector comprising a supporting bow or frame, a tube supported transversely by said frame and perforated and containing a lubricant, and a series of contact rolls mounted to rotate on the tube.

639,948. JUNCTION BOX OR OTHER COUPLING FOR CASINGS FOR ELECTRIC CABLES OR WIRES; A. Sundh, Yonkers, N. Y. App. filed Aug. 12, 1899. The box is provided with compressible packing at the points where the cables enter it, so that in clamping the parts of the box against the rough surface of the cable, a good grip will be taken thereon.

639,957. REGULATOR FOR DYNAMO ELECTRIC MACHINES; R. E. Ball, New York. App. filed Feb. 13, 1899. A part of the magnetic circuit is used to actuate a multiplying gearing connected with the brush carrying yoke.

640,001. ELECTRIC FUSE; I. Kitsee, New York. App. filed June 26, 1899. A magazine fuse block, in which the terminals of the circuit to be provided with fuse are normally kept together and separated or held apart by non-conducting material, if it is desired that the path of the current shall be only through the fuse.

640,006. STORAGE BATTERY; C. Lindenberger, H. Lindenberger and W. B. Teal, Hannibal, Mo. App. filed Oct. 7, 1898. (See Current News and Notes.)

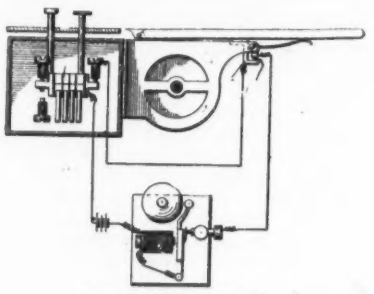
640,009. TROLLEY WHEEL; G. E. Mittinger, Jr., Cleveland, Ohio. App. filed April 21, 1899. The wheel consists of three parts, a grooved shell adapted to bear against the wire, and two hub portions adapted to clamp the opposite sides of the shell. By this means worn parts may be replaced.

640,050. ELECTRIC HAIR BRUSH; J. Werntz, Annapolis, Md. App. filed May 10, 1899. A case for the battery is fastened to the back of the brush body and a casing for the induction coil is fastened to the back of the handle, a switch and circuit interrupter being mounted in a convenient place.

640,062. AUTOMATIC CIRCUIT BREAKER; E. F. Winfield, San Francisco, Cal. App. filed Nov. 2, 1898. The contacts are so arranged that upon a momentary abnormal condition, the circuit is opened and immediately thereafter closed, a locking device being thereby adjusted so that if the abnormal condition continues the circuit is immediately opened again and held open.

640,143. ELECTRIC HEATER; R. Lundell, New York. App. filed May 24, 1898. The resistance wire is made up in the form of an open work screen which is placed in front of an electric fan, the current of air produced by the fan being thereby heated.

640,146. ELECTRIC RAILWAY; G. W. McClintock, Wollaston, Mass. App. filed Oct. 21, 1898. Details of construction of the switch box used in a third-rail system.



639,716.—Telautograph.

640,153. SIGNAL PLATE; E. E. Yaxley and C. C. Cadden, Chicago, Ill. App. filed Feb. 25, 1899. An annunciator drop comprising a plate having its display face serrated to display the faces or corresponding sides of the teeth in one position of the plate and the faces of the opposite sides of the teeth in the other position thereof. The sides of the teeth in one instance are painted a certain color, while the sides in the other instance are painted a contrasting color.

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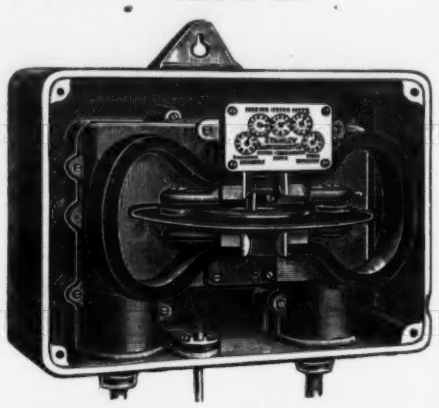

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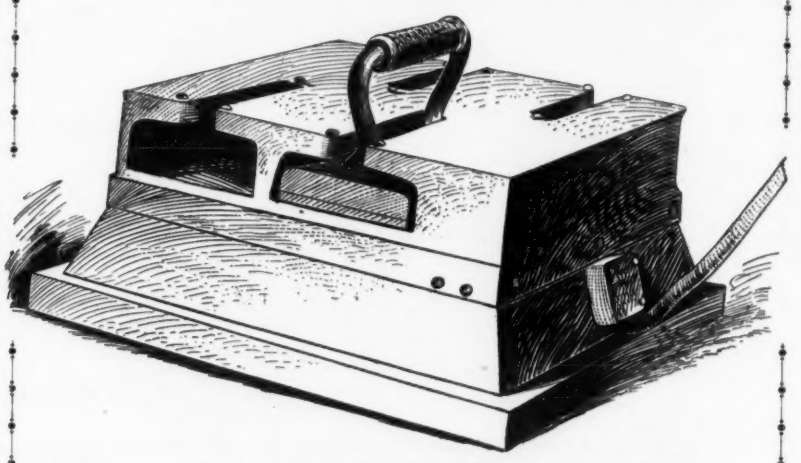

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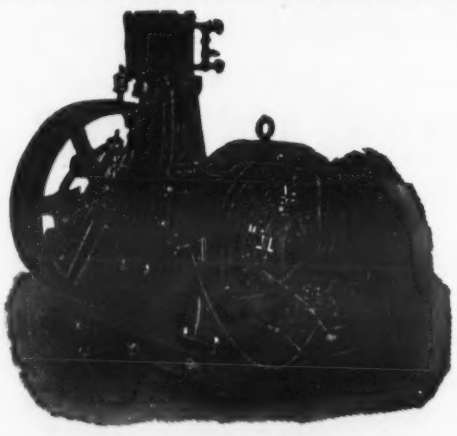

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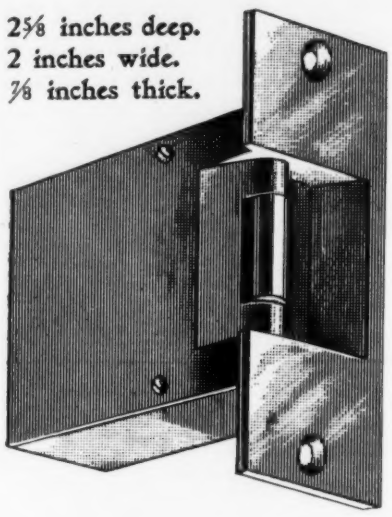

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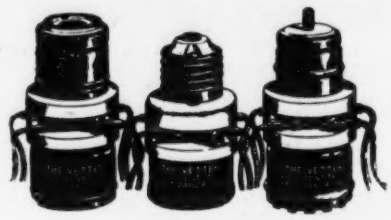

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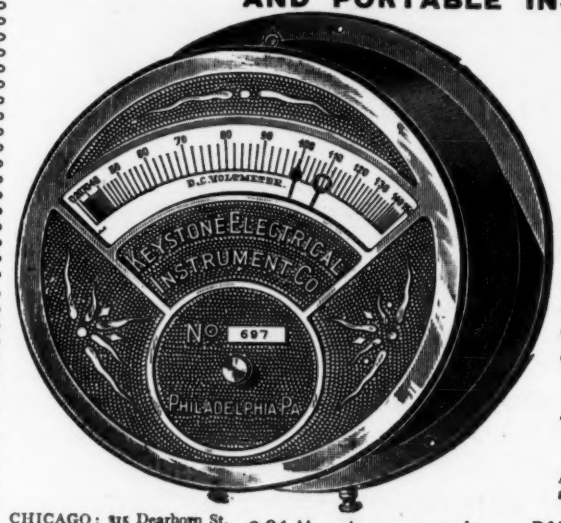

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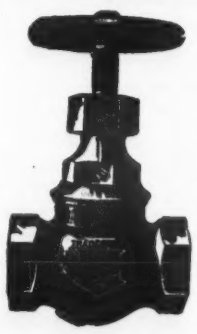

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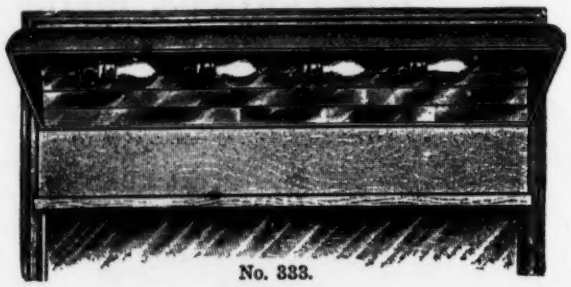
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